ON THE COVER

A "HIGH-BALL" method of felling trees, conceived by S.L. Wixson of Wixson & Crowe, Inc., and John Trisdale of J.H. Trisdale., Inc., both of Redding, Calif., is being employed successfully by their firms in clearing the reservoir area behind Hungry-Horse Dam which is being built on the south fork of the Flathead River in Montana. Revolutionary in character, it is a modification of a scheme that was used by the same contractors last year when, in working on burned-over land, they strung up to 400 feet of wire rope between two diesel-driven Caterpillar tractors and snagged down trees and brush caught in the loop as the vehicles slowly advanced on parallel paths.

When this method was tried in the Hungry Horse area, it soon became evident that it would not work, because the cable got hung up on the stumps of large merchantable trees that had been cut for timber. It was then that the two men came up with the idea of the ball, the purpose of which is to keep the cable riding high enough to clear the stumps.

The 4½-ton, 8-foot-diameter sphere, made of ¾-inch boiler plate, is put in the middle of the cable line between the two "Cats." It turns on a central 6-inch-diameter shaft mounted in Timken roller bearings that are lubricated by keeping 8 to 10 gallons of oil in the ball. Attached to each end of the shaft is approximately 200 feet of 1½-inch wire rope, terminating in a swivel and jewels for connection to a 1¼-inch cable extending from its tractor—this being done to prevent twisting and snarling of the line.

The tractor cables are wound on winch drums, which permit running them out as desired up to lengths of 900 feet. In making a "pull," the "Cats" bulldoze their way through the forest on approximately parallel paths several hundred feet apart, the distance varying with the terrain and the size of the trees to be brought down. When the operators have played out their lines, they anchor their tractors to large trees or stumps and start reeling in the cables on the two winches. The ball travels through the timber about as fast as a man walks, and the trees caught in the loop are uprooted and felled as though struck by a hurricane.

With one of these outfits, of which five are available, as many as 200 acres of heavily timbered land have been cleared in four hours. Initial bids on the job of clearing 22,905 acres were considered too high and the Government called for new ones. Gambling on the effectiveness of their innovation, Wixson and Trisdale submitted a bid that was nearly $2,000,000 less than the lowest figure originally asked.

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C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Advertising Mgr.*
A. W. LOOMIS, *Assistant Editor* JOSEPH C. DILTS, *Advertising Sales*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E. C. 4.
F. A. McLEAN, *Canada*, New Birks Building, Montreal, Quebec.

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The House of Tata

Seeds Sown by India's Pioneer Industrialist Have Grown into an Empire of Ramified Enterprises Employing 125,000 Persons and Supporting Vast Charities

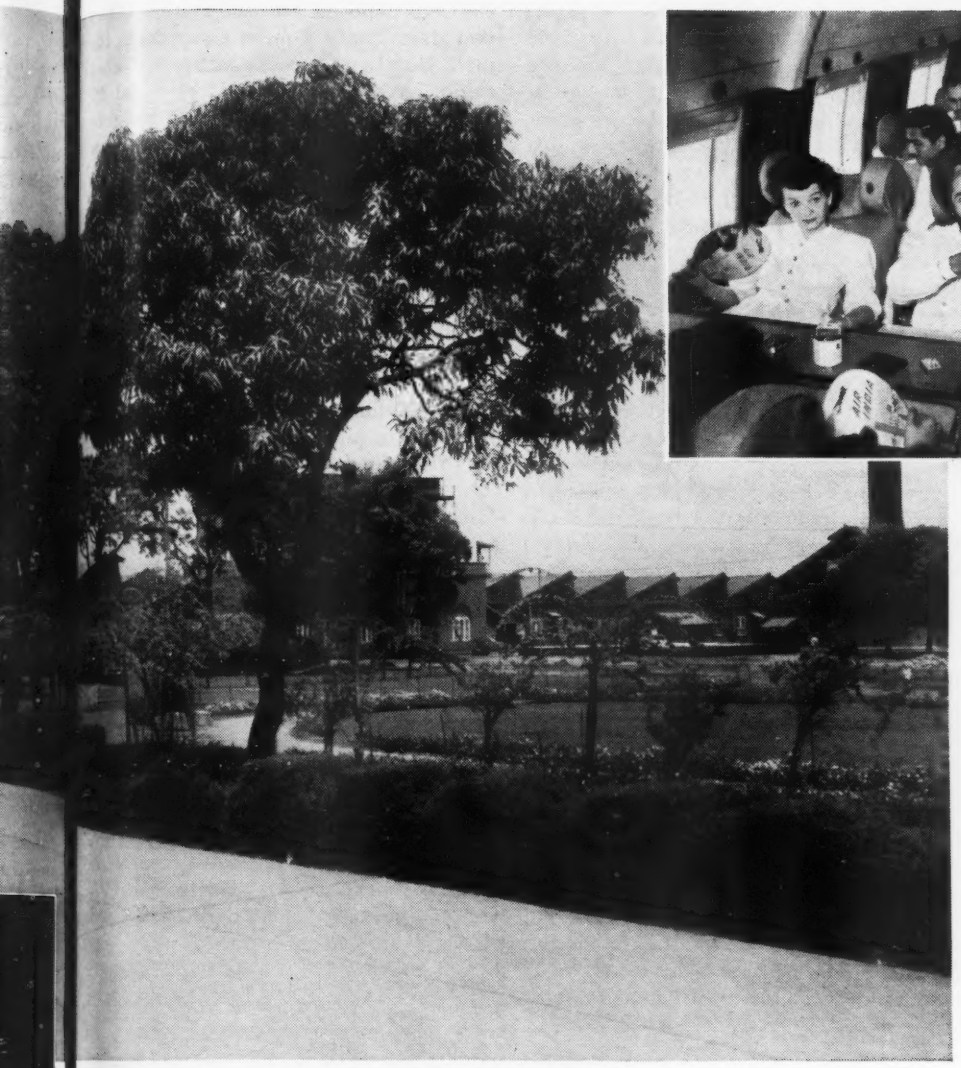
E. T. Warren

IF YOU ever happen to visit the City of Delhi, India, drive out to the Qutab Minar and see that great redstone edifice towering well over 100 feet into the air. Within range of its shadow, you will find standing there an iron column that is 12 to 16 inches in diameter, 24 feet high, and weighs more than 6 tons. This pillar was erected in the year 410 A.D. during the reign of Chanda Gupta II. Examine it well. In its entirety—lotus-flower cap, hieroglyphics, and all—it is as sound and oxygen-defying as it was when erected 1500 years ago.

The historian knows when it was made. The chemist knows its analysis. The physicist knows its specific gravity. The metallurgist knows its grain structure. No one knows the secret of its making! It is an established fact, however, that iron ore was being reduced in India more than 2000 years ago by forcing air, by means of a blowing apparatus, through a blowpipe and tuyere into a cylindrical refractory shaft furnace filled from the top with alternate layers of hematite ore and a solid fuel. Two thousand years ago, and yet this description might fittingly be applied to our modern, 1000-ton blast furnaces which are virtually nothing more than great-great-grandchildren of those ancient Indian jungle furnaces.

These little furnaces, if blown for eight hours, produce casts of only 20 pounds. Therefore, if the iron column at the Qutab Minar had been made by that method, it would have taken nearly 700 furnaces, tapped simultaneously, to furnish the required tonnage. Chanda Gupta II must have sent many subpoena-armed messengers to the four points of the compass to gather together the necessary charcoal burners and ironmakers. Once assembled, there was held what was in all probability the first, largest, and noisiest Blast Furnace and Charcoal Burners' Association meeting in the world.

Although the pillar was erected as a symbol of victory of some great battle, it might well have been dedicated to the artisans who so skillfully made it and who were the forerunners of the steelworkers born in India fifteen centuries later. There, even before the advent of Christ, were to be found the raw materials and the man-power for a steel industry. However, it was not until 1839 that one appeared who, later, had the vision, the courage, and the tenacity to bring it about through the erection of a



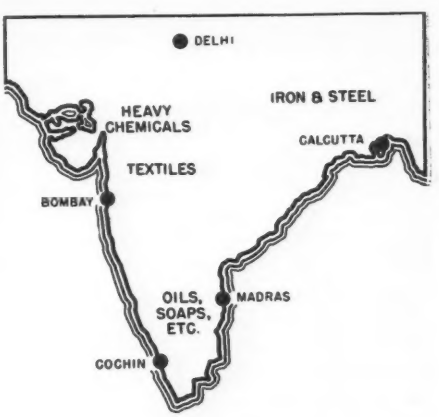
VARIED TATA ENTERPRISES

Some 75 years ago, Jamshedji Tata, then a young man, launched India's textile industry by converting an oil mill into a cotton-spinning and weaving plant. After selling it at a profit, he went to London to learn more about the art and was told that India's climate was unfavorable to textile manufacture. Only Lancashire, with its year-round humidity, was then considered suitable for making high-grade cotton fabrics. Disbelieving this in the light of his experience, Tata returned home, built mills, and equipped them with a crude system of air conditioning. Because they were opened on the day in 1877 Queen Victoria was proclaimed Empress of India, he called them the Empress Mills. That was the beginning of Indian industry and the foundation upon which the ramified Tata enterprises have risen. Even in those first mills the elder Tata showed deep interest in his workers, providing recreation grounds, as well as libraries and reading rooms to enable them "to think beyond the four factory walls." The entrance to one of Tata's modern cotton mills is pictured above. Its principal products are sheets, pillowcases, toweling, and loose-woven materials for clothing suitable for the warm climate. Synthetics such as rayon are used in combination with cotton, but not alone. India is a large grower of short-staple cotton but imports its requirements of the long-staple variety from Egypt. The Tata Oil Mills Company, Limited, established in 1918, is the leading Indian manufacturer of soaps, detergents, glycerine, perfumes, edible oils, and related products. The entrance to the mill at Tatapuram is shown at the upper-left. The Taj Mahal Hotel in Bombay, opened in 1904 at a cost of $1,275,000, has 300 rooms. Its air-conditioned dining room is illustrated at the left. Half way between Bombay and Calcutta a stewardess serves a meal aboard an Air-India Limited Viking plane, as seen at the upper-right. Tata's present board chairman, J.R.D. Tata, took up flying twenty years ago and in 1932 established the line that now covers India. Air-India International, known as "The Route of the Magic Carpet," operates the fastest service between London and Bombay, using Constellation planes.

plant that was to become the biggest in the British Empire. That man was Jamshedji Nusserwanji Tata. Throughout India he is known as the "Founder"—founder of the present House of Tata which has built up the largest single aggregation of Indian industries, including steel and textiles, electric power and soaps, airlines and hotels, locomotives and radios.

Mr. Tata was a Parsi, one of the Zoroastrian faith—one of those who, 25 generations before his time, had fled to India from Persia to escape the persecution of the Mussulman. The Avestan-worded motto of the Parsi religion is *Humata, Huxta, Hvarsta,* meaning "Good Thoughts, Good Words, Good Deeds." The House of Tata was built on those precepts and, though industrial enterprises entered into were and are meant to pay, monetary returns have always been only a means to an end—the prosperity of India. What was done, was done in a spirit of service to the nation. Mr. Tata was a business patriot. His followers have been and are the same.

Although steel is the largest of its multitudinous industries, it was actually textiles upon which the house was founded. It was in 1869 that Mr. Tata first became the owner and operator of a cotton mill which he soon sold at a profit. Five years later the Central India Spinning, Weaving & Manufacturing Company, Ltd., was registered in Bombay, and on January 1, 1877, the Empress Mills were formally opened. That was the true beginning, and that self-same concern is in business today. Between then and 1913 it was supplemented by three other textile companies. Known as the Tata Textile Group, they have more than 37,000 employees working on 286,000 spindles



TATA INTERESTS

Partial map of India, showing general locations of Tata's main enterprises exclusive of the air lines.

and 7100 looms. It was the first company that brought Mr. Tata the confidence, the reputation, and the money to branch out into other industrial fields and to set up charitable and educational institutions.

As far back as 1882, Mr. Tata had become interested in the making of iron in India. Knowing that there were both coal and ore in the central provinces, he advertised in trade journals, offering a reward for a method of smelting. None that was wholly suitable was submitted, but several good ideas were forthcoming. So he split the reward and finally asked the government for a concession to work the deposits. India was still influenced by Lord Lawrence's famous "I know what private enterprise means! It means robbing the Government!" Mr. Tata did not get his concession.

In 1899, Lord Curzon was responsible for a change in mining and prospecting regulations, and in 1900 Mr. Tata, after visiting London, was allowed to do some prospecting. It was not until the fall of 1902 that worth-while plans were laid. That year he visited the United States and was well received by many, including Mark Hanna, Myron Herrick, Judge Elbert H. Gary, and Julian Kennedy, who recommended Charles Perin as consulting engineer. For the geological work, the latter sent C. M. Weld out to India, and he started his explorations of the Indian jungles in April of 1903.

From 1906 to 1907 negotiations were carried on with England for the purpose of financing the proposed steel plant. Every possible obstacle seems to have been thrown in the way, with the result that the Tata interests, in desperation, at last gave up the idea of asking for foreign capital and decided to try an unheard of venture—to turn to the Indian people. The outcome is best described by quoting from a lecture delivered by Mr. Kennedy's partner to the Staffordshire (England) Iron & Steel Institute:

"From early morning till late at night, the Tata offices in Bombay were besieged by an eager crowd of native investors. Old and young, rich and poor, men and women they came offering their mites, and at the end of three weeks the entire capital for the construction requirements—£1,630,000—was received, every penny contributed by some 8000 native Indians. And when, later, an issue of debentures was decided upon to provide working capital, the entire issue —£400,000—was subscribed for by one Indian magnate, the Maharajah Scindia of Gwalier."

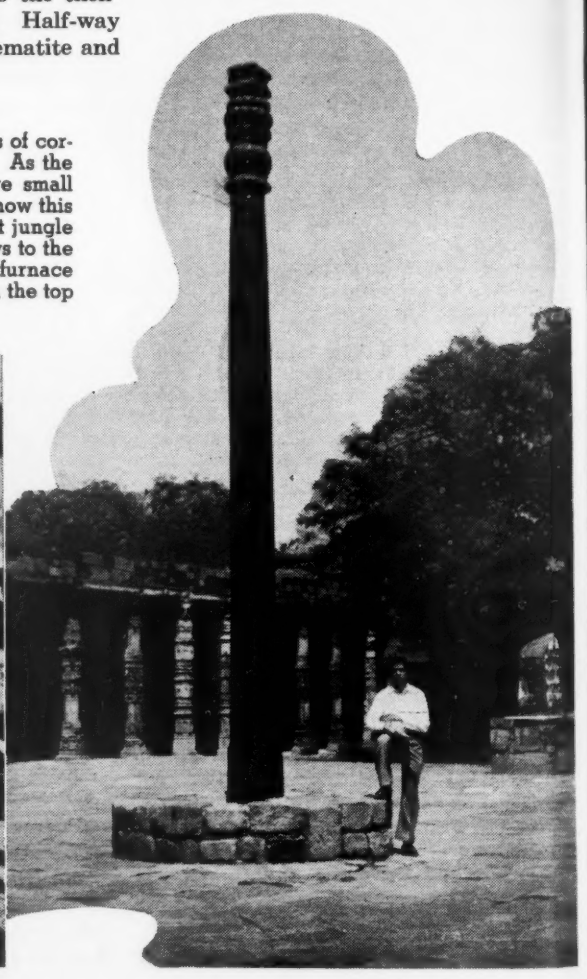
It was in 1908 that the first stake was driven at Jamshedpur, in the midst of an elephant- and tiger-infested jungle. The location was an eleventh-hour choice. Plans to build near the ore deposits in the central provinces were well underway when a Bengali prospector discovered a mountain of high-grade ore in the State of Moarbhanj, which was several hundred miles nearer to the then-operating Jharia coal fields. Half-way between this mountain of hematite and the coal deposits was the confluence of two rivers, only 4 miles away from the main Bombay-Calcutta railroad. What could have been more ideal—coal 60 miles to the north, iron ore 60 miles to the south, dolomite and limestone less than 200 miles to the west, and the Port of Calcutta 150 miles to the east.

On December 2, 1911, the first iron was tapped, and the first basic open-hearth heat was poured during the following year. Mr. Tata, the Founder, saw neither, for he died in 1904. In the meantime, the steel mill has become fully integrated, with a capacity of well over one million tons of ingots. With the exception of pipe, the products are fairly well diversified. During the years, allied industries have sprung up in and around Jamshedpur that have taken both semi-finished steel and electric power from the works. These plants produce tin plate, wire products, electric cable, steel-mill rolls, castings, and road rollers, and in the near future will turn out locomotives.

While the little jungle village of 1908 has grown into a city of more than 200,000, the burden of providing and administering all municipal services has fallen upon the company. It has built nearly 10,000 quarters for its staff. Roads, water, sewage, schools, hospitals, recreation centers—all have been financed by the company. A research laboratory—probably the largest of its kind

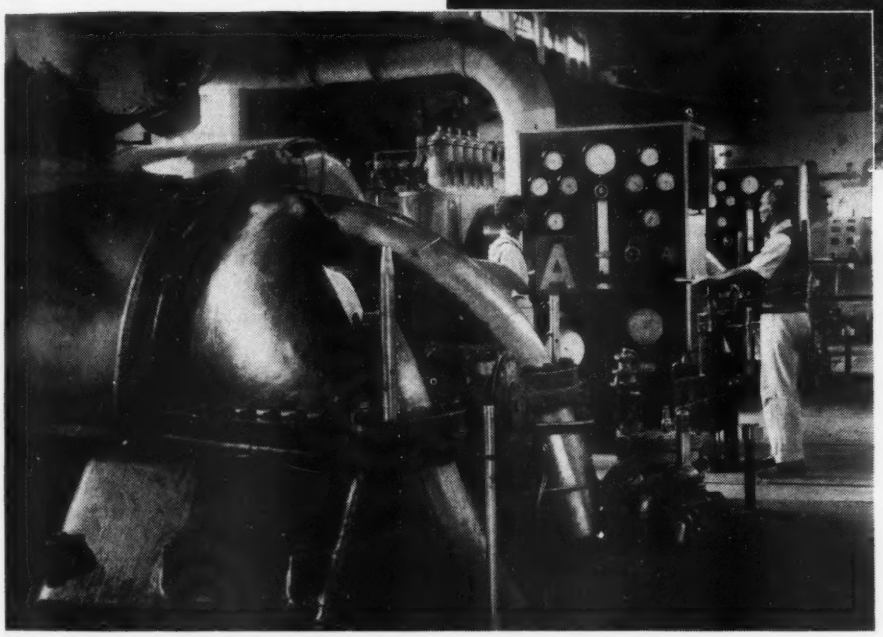
THE DELHI PILLAR

Erected fifteen centuries ago, this 24-foot-high column still shows no signs of corrosion. The composition of the metal approximates that of wrought iron. As the only iron-smelting equipment known to have been in use at that time were small furnaces with a capacity of 20 pounds in eight hours, it is not known just how this 6-ton monument came into being. A modern foot-operated version of that jungle furnace is pictured below. The operator shifts his weight from one bellows to the other to pump combustion air at the rate of about 2 cfm. into the base of the furnace through a blowpipe and tuyere. As he raises a heel, he uncovers a hole in the top of the bellows, thus admitting air for the next "blow."



MODERN BLAST FURNACE AND BLOWER

In striking contrast to the puny "blowing engine" illustrated on the preceding page is the Ingersoll-Rand 90,000 cfm., turboblower pictured below. It is one of several that furnish air for five blast furnaces at the Tata Iron & Steel Company's plant. The view at the right shows pig iron running from a 22½-foot open-hearth furnace that produces from 1000 to 1200 tons of metal a day.



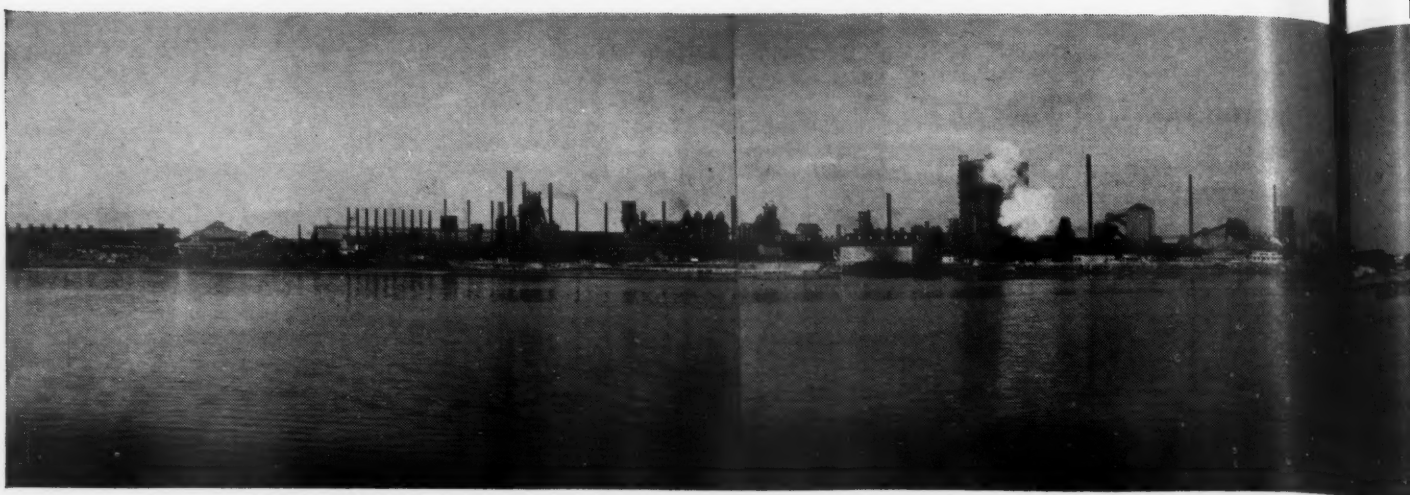
owned by an individual steel plant—was established twelve years ago. A technical school is maintained where college and university graduates are trained for work of a supervisory capacity and boys of high-school age are taught various trades. This school, in particular, is responsible for the mill's present extremely small staff of foreigners. Furthermore, it has always been a part of every "European's" job to help train an Indian to eventually take his place. Twenty-five years ago there were several hundred Europeans and Americans in the Jamshedpur plant. Today, there are less than twenty. Jamshedpur has always been on 8-hour shifts. Equal donations from the company and employees toward a provident fund, vacations with pay, and profit-sharing bonuses proportionate to dividends paid, are old-time stories at Jamshedpur.

During the later days of the past and the early ones of the present century, J. N. Tata, while dreaming of and planning a steel business, had in mind another major scheme, that of harnessing the monsoon rains that fall on the western Ghats and providing Bombay and vicinity with electric light and power. Although investigations along these lines were started in 1907, it was not until 1910 that the Tata Hydro-Electric Power Supply Company Limited came into being and Bombay's tramcars moved under hydro-power. Six years later the Andhra Valley Power Supply Company Limited was established, and it was soon followed by the Tata Power Company Limited.

In 1937, United Power Limited brought about the completion of the Tata Hydro-Electric System which is operated as an integrated network or "grid" and serves an area with an estimated population in excess of 4,000,000. It is the largest in India, with an annual output equal to nearly 30 percent of India's total production. The present generating capacity of the three hydroelectric stations is 230,000 kw., and the rated capacity of the interconnected steam-electric station of the railway is 40,000 kw. The system maintains 800 circuit miles of high-voltage transmission lines, including 458 miles of 100,000-volt capacity. Current is delivered to Bombay's textile mills and other important industries, to suburban areas, to railways for electric traction, and to local authorities. It is also sold in bulk for retail distribution to electrical undertakings supplying Bombay City and outlying districts, Poona, and several other localities in the area.

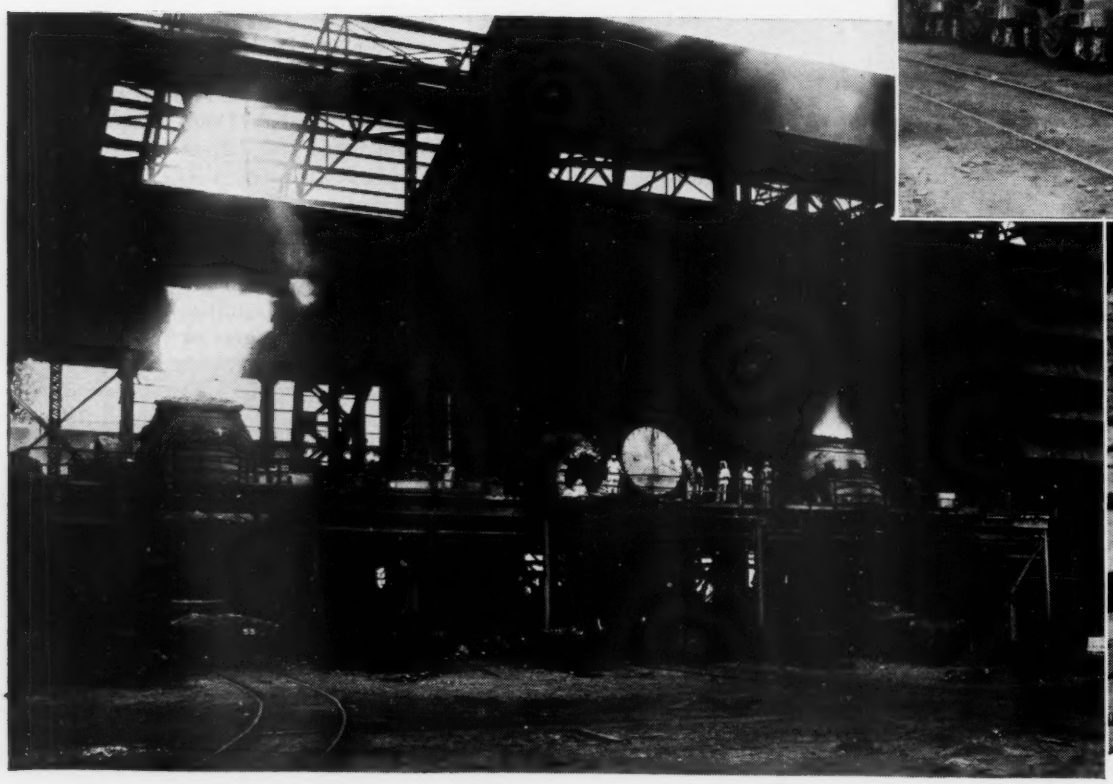
Just as Jamshed Tata dreamed and laid the foundation for textiles, stee,l and hydroelectric power, so did J.R.D. Tata, the present chairman, dream and lay the foundation for the Tata Air Lines. It was in 1932 that the aviation department was established. In 1946 it became a public limited company and the name was changed to Air-India Limited. This line operates between Karachi/Bombay, both via Ahmedabad and nonstop; and between Bombay/Delhi, nonstop or via Ahmedabad and Jaipur. There are two Bombay/Calcutta flights daily; one a day between Bombay/Colombo, with stops at Madras and Trichinopoly; and service is maintained between Madras/Trivandrum via Bangalore, Coimbatore, and Cochin. In addition to these scheduled flights, Dakotas or Vikings are obtainable for charter trips.

In flying from Bombay to Karachi, one passes over the Cutch of Kathiwar, the only place in India where lions are still to be found. At its western tip on the Arabian Sea is Port Okra, and a few miles away, also on the sea, lies Mithapur, the home of Tata Chemicals. After incoming tides have filled the acres of evaporating basins located there, great gates are lowered. Winds blow across these basins every hour of every day, and evaporation is very rapid. The list of products from Mithapur are numerous, and include soda ash, caustic soda, bicarbonate of soda, chlorine, zinc chloride, sodium and potassium bromide, bleaching powder, magnesium oxide, epsom salts, magnesium and potassium chloride, hydrochloric acid, liquid bromide, hydrated lime, and kainite. There Tata has built another town, complete with medical and recreational facilities.



A DREAM COME TRUE

When Jamshedji Tata set out to make India an industrial nation, he knew that he must first turn out the basic metals, iron and steel. Of the three essential raw materials—iron ore, limestone, and good metallurgical coal—all but the last-named were known to exist there. When, after 25 years of searching, he found coal of coking grade within easy reach of the iron deposits, the way to the realization of his dream was open. Choosing a centrally located jungle village called Sakchi as the site, he planned his steel mill but died in 1904, leaving the construction to his sons. Two years later English financiers declined to advance money for what they considered an ill-advised scheme. Turning to the Indian people themselves, the younger Tatas raised the funds by popular subscription, and the Tata Iron & Steel Company was formed in 1907. When World War I broke out in 1914 the plant was greatly enlarged, again with money advanced by Indians, to help supply Great Britain with vitally necessary steel. Today it has an annual ingot capacity exceeding a million tons and complete facilities for transforming iron ore into the numerous steel shapes and products for India's economic needs. It is pictured above, looking across ponds of water used for cooling purposes. The length, from end to end, is about 2 miles.



BESSEMER CONVERTERS

Two of these pneumatic steel makers are shown blowing, with the central one out of service while receiving a new refractory bottom. The Bessemer setup is almost identical with that at the Gary, Ind., works of Carnegie-Illinois Steel Company (U.S. Steel).

CHIPPING STEEL SLABS

In India, too, pneumatic chipping hammers save time and money in freeing billets of surficial imperfections that might affect the soundness of products rolled from them.

DIESEL-ELECTRIC LOCOMOTIVE

Further evidence of the modernness of Tata operations is presented at the left. Since 1935, this American-built (Ingersoll-Rand, General Electric, American Locomotive Company) unit has handled haulage jobs around the plant. It is shown leaving the blast-furnace area with 250 tons of molten iron in ladle cars.

PREPARING TO RELINE AN OPEN-HEARTH FURNACE

After from four to six months of searing service, open-hearth furnaces must be given new refractory linings. In India, as elsewhere, the fused slag and cinder accumulations are broken out with air-operated paving breakers. Two Tata employees are shown at the left performing this operation with tools that emphasize how small the Indian is in stature.

CHILDREN'S DAY NURSERY

Mothers who work in the steel mill bring their children with them to be cared for in plant creches such as the one shown here. The day-nursery idea is an old one with the Tatas, having been introduced in the Empress textile mills in 1877.

VIEWS IN JAMSHEDPUR

Since 1907, the jungle village of Sakchi has grown into a steel-mill city of 150,000. Called Jamshedpur after the founder ("pur" means town or little city), it is 150 miles west of Calcutta. Water for the mills is taken from the nearby Subarnarakha River, literally "River of Gold" (a hand panner can still glean about twenty cents worth of the yellow flecks daily from its gravels). The domestic supply, safeguarded by accepted practices, comes from a reservoir (lower picture) in the Singbaum Hills. Although the elder Tata did not live to see the city, he cut the pattern for it and directed that it should have none of the unattractiveness of typical steel-mill towns the world over. His concern for the welfare of his employees lives on. Jamshedpur's milk comes from a scientifically run dairy farm, and food shops are regularly inspected by qualified health officers. The children go to 70 Tata schools, staffed by 500 teachers. The sick are attended by 45 doctors in the company's hospital. Steel-mill workers get a basic wage, plus attendance and performance bonuses, and also share in the profits. In good years, these extra payments amount to as much as 3½ months of their basic pay. The company has built 10,000 houses and erects more each year. Those shown at the top are constructed of stuccoed red brick and are for foremen. As befits the climate, rooms have high ceilings and each contains an overhead punkah or fan operated by electricity—a great improvement upon the traditional means of cooling by a curtain pulled back and forth by a servant.

The newest of the Tata ventures is Air-India International Limited which, in conjunction with the Government of India, operates from Bombay to London via Cairo or by way of Basra, Cairo, and Geneva. It is the quickest way to reach Bombay from England and has all up-to-date Constellations on the run. The Sunday flight, which stops only at Cairo, leaves London at 10:15 a.m. and arrives at 1:30 p.m., Monday—elasped time, 21 hours and 35 minutes. A regular scheduled trip has actually been made in 17 hours and 55 minutes. During "Holy Year" stops are made at Rome. A weekly Bombay-Nairobi service is maintained, a schedule that is to be changed in the near future to two flights a week. Truly, this line is well named—"The Route of the Magic Carpet."

If you have ever sailed into Bombay Harbor you have seen, off the port side, the gray stone structure that is called the Gateway of India. Behind it, you could not help but notice three impressive-looking buildings. The first is the East's finest hotel, the Taj Mahal; the second is Green's Hotel; and the third is the former Bombay Yacht Club—all owned by Tata. The 300-room Taj, which came into operation in 1904, was built by Mr. Tata, the Founder, because he once heard a foreigner denounce Bombay because it lacked a decent hotel. It has kept abreast of the times, and now has as fine an air-conditioned dining room and as modern a kitchen as can be found anywhere. It is claimed that one of the world's most beautiful sights is to be seen at Agra when the moon is full and shining over Shah Jehan's Taj Mahal. But sitting in the Taj Mahal Hotel and watching the full moon rise over the hills across Bombay Harbor is also a spectacle one is not likely to forget.

In 1918, Tata Oil Mills Company Limited was organized for the manufacture of both washing and toilet soaps, glycerine, perfumes, eau-de-colognes, edible oils, detergents, and polishes. The main factories are in Bombay and in another "Tata Town"—Tatapuram—in Cochin State. Most of the vegetable oils processed are cocoanut, groundnut, and sesame. Gross sales from these plants exceed 30,000,000 rupees a year ($6,300,000 at the present rate of exchange). There are many cement plants scattered throughout India, but in 1936 a combine was formed which acquired nearly all of them, including Tata's two companies. Cement is one of the large industries in India and is continually expanding, with a program for 3,000,000 gross tons a year.

In 1937, Tata Sons founded the Investment Corporation of India with the idea of giving stockholders diversified investments the world over in sound securities. For the purpose of aiding Indian industrialization, it also helps to float new firms, and now has several subsidiaries which turn out inexpensive radios, welding electrodes, pickers for textile mills, machine tools, and enamelware. Another concern is engaged in the recovery of nonferrous metals from scrap for conversion into alloys and bearing metals. Years earlier—in 1919—the New India Assurance Company was started and is the largest composite insurance company in India today. The Commercial Printing Press, organized in 1862, is run by Tata and does all the printing for its varied establishments.

During the last war, India furnished many Bren-gun carriers for the Egyptian Campaign. The armor plate was made by the steel company and erected on Canadian Ford chassis at a plant a few miles east of Jamshedpur. Upon cessation of hostilities it was taken over by Tata, and a company was organized with the object of making road rollers, locomotive boilers, and finished steam locomotives. At the present time the two former items are in production, and

sometime in the near future India and Tata will put the first completely Indian-constructed steam locomotive on the road. In addition, the company expects to undertake heavy engineering works and to manufacture agricultural machinery and motor-car components.

All these varied industries are controlled by Tata Sons Limited, a private limited company which has grown from a small trading firm formed by Jamshed Tata in 1887 with a capital of less than $7000. Until 1945, it acted as managing agents for the various concerns, but since then a new subsidiary, known as Tata Industries Limited, has taken over most of the agencies. The major portion of the capital of Tata Sons Limited, amounting to 85 percent, is held by trusts which are all philanthropic and were originally endowed by members of the Tata family.

The J.N. Tata Endowment for Higher Education was founded more than 50 years ago by the late J.N. Tata mainly with a view to enabling Indians to receive their training in England so as to compete on the same terms with British graduates entering the Indian Civil Services, from which they were practically debarred. Graduates of exceptional promise are advanced funds for their maintenance and education abroad on condition that they be repaid and thus made available again to others. Tata scholars include eminent doctors, economists, civil servants, and scientists. The present tendency is to send out men for scientific and technical training to meet the growing industrial needs of the country.

The Indian Institute of Science, which is situated at Bangalore in Mysore State and admitted its first students in 1911, owes its establishment to a munificent endowment by Jamshedji Tata. The State provided a large plot of land for its construction, as well as financial support. Now, recurring expenditures are met mainly by the income from properties, investments, and annual grants from the Mysore Government and the Government of India. The institute is a living force in Indian scientific training and research and is well equipped with laboratories for post-graduate work in physics, in physical, inorganic, and organic chemistry, in biochemistry, chemical technology, chemical engineering, electrical technology, as well as aeronautical engineering.

TATA DIRECTORS MEET

In the niche beyond the table in the board room at Bombay House is a bust of the founder. The painting at the extreme right is of R.D. Tata, former board chairman and father of J.R.D. Tata, the present incumbent shown presiding. The other portrait is of Sir Ratan Tata, the founder's youngest son. Seated second from the right is Dr. John Matthai, recently India's finance minister.

In 1919, under the will of Sir Ratan Tata, was created the Sir Ratan Tata Charities. Among the aims and objects of this trust are the relief of distress and poverty, medical aid, social welfare, and education. As a memorial to his wife, the late Sir Dorabji Tata established the Lady Tata Memorial Trust in 1932. A fifth of the net income from this endowment is earmarked for Indians in India or abroad to encourage them by awards for any scientific investigation which has a bearing directly or indirectly on the alleviation of human suffering caused by disease. The remainder is for prizes, scholarships, fellowships, and grants open to candidates of all nationalities engaged in research in diseases of the blood, with special reference to leukemia. The trustees act upon the recommendations of two advisory committees, one for the Indian awards with headquarters in Bombay and the other for the international awards (research in diseases of the blood) with headquarters in London.

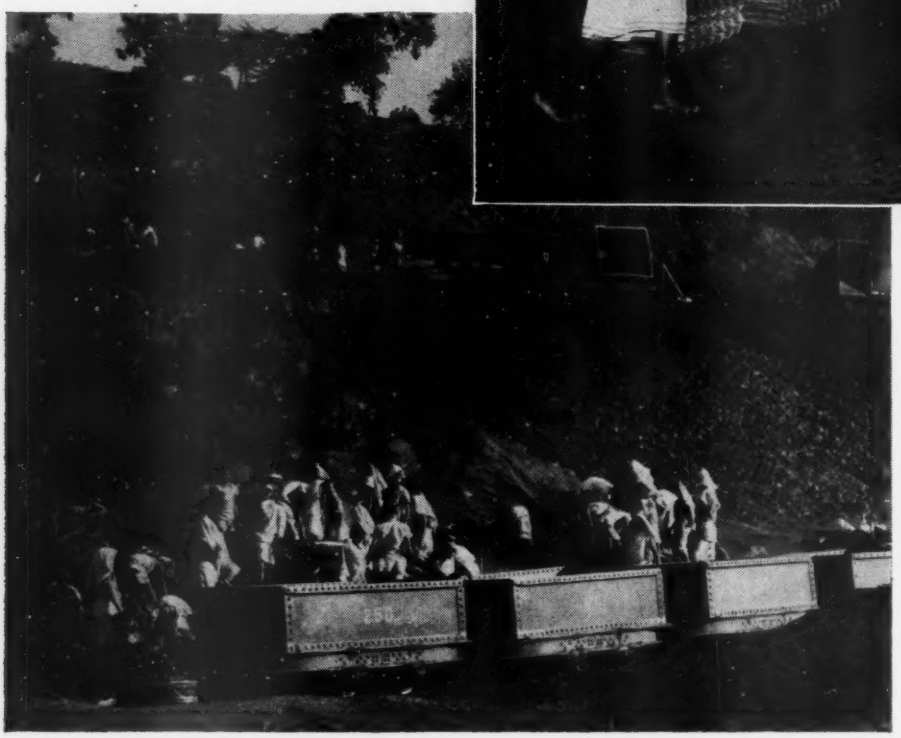
Also in 1932, Sir Dorabji Tata founded the Sir Dorabji Tata Trust for the benefit of humanity, without distinction of place, nationality, or creed. Among its objects are the relief of distress caused by the elements—by famine, pestilence, fire, tempest, flood, and earthquake; the advancement of learning in all its branches, especially research in connection with medical and industrial problems; and the support of educational institutions and the granting of scholarships.

TATA MEMORIAL HOSPITAL

This modern institution in Bombay, dedicated to combating the scourge of cancer, is financed by Tata profits, 85 percent of which are expended for the advancement of the Indian people. The administering trusts seek to carry out Jamshedji Tata's credo, "Let the Indian learn to do things for himself."

WOMEN WORKERS IN MINE AND MILL

Women's work consists chiefly of "head loading." In the iron mines (below) they carry blasted material to cars in baskets. A typical steel-mill job is the transportation of galvanized sheets (right). No matter what she carries, the Indian woman puts it on her head, a custom that makes for upright posture and grace of motion. In India almost everyone dances, and training starts at the age of three by balancing a dish on the head.



Four years later the same trust established the Tata Institute of Social Sciences. It is the first and only one of its kind in India and offers a 2-year course of training in the social sciences to graduates of the country's universities. It aims to maintain a high academic standard and, at the same time, to provide public and industrial organizations with professional social workers. The course of instruction covers general sociology, psychology, pathology, ethics, statistics, criminology, public-welfare administration, industrial relationships and psychiatry, juvenile delinquency, and child welfare. The institute's Child Guidance Clinic has a staff of many specialists and serves as a laboratory for the students. Scholarships are awarded to stimulate social research, a field which has been much neglected in India. On the institute's faculty, from time to time, are visiting professors from foreign universities.

Tata Memorial Hospital was constructed and equipped by the Sir Dorabji Tata Trust in 1941 and is the first in the country to specialize in the treatment of cancer by every known effective method. It is a model institution and is also an all-India center for research into the origin, forms, treatment, and prevention of this major scourge. In June, 1945, the trust, in coöperation with the Government of Bombay, founded the Tata Institute of Fundamental Research. It is under the management of a council on which both the government and the trust are represented. A few of the best post-graduate students from all parts of India are admitted, and members of the staff give advanced lecture courses in physics, mathematics, and allied sciences. At present, work of special importance in the field of theoretical physics and cosmic radiation is in progress at the institute's temporary home in Bombay.

Jamshedji Nusserwanji Tata, who directly and indirectly brought into being the House of Tata with its manifold branches, is buried at Brookwood, England. His tombstone bears an inscription from Browning that suits him well:

Lofty designs must close in like effects:
Loftily lying,
Leave him — still loftier than the world suspects —
Living and dying.

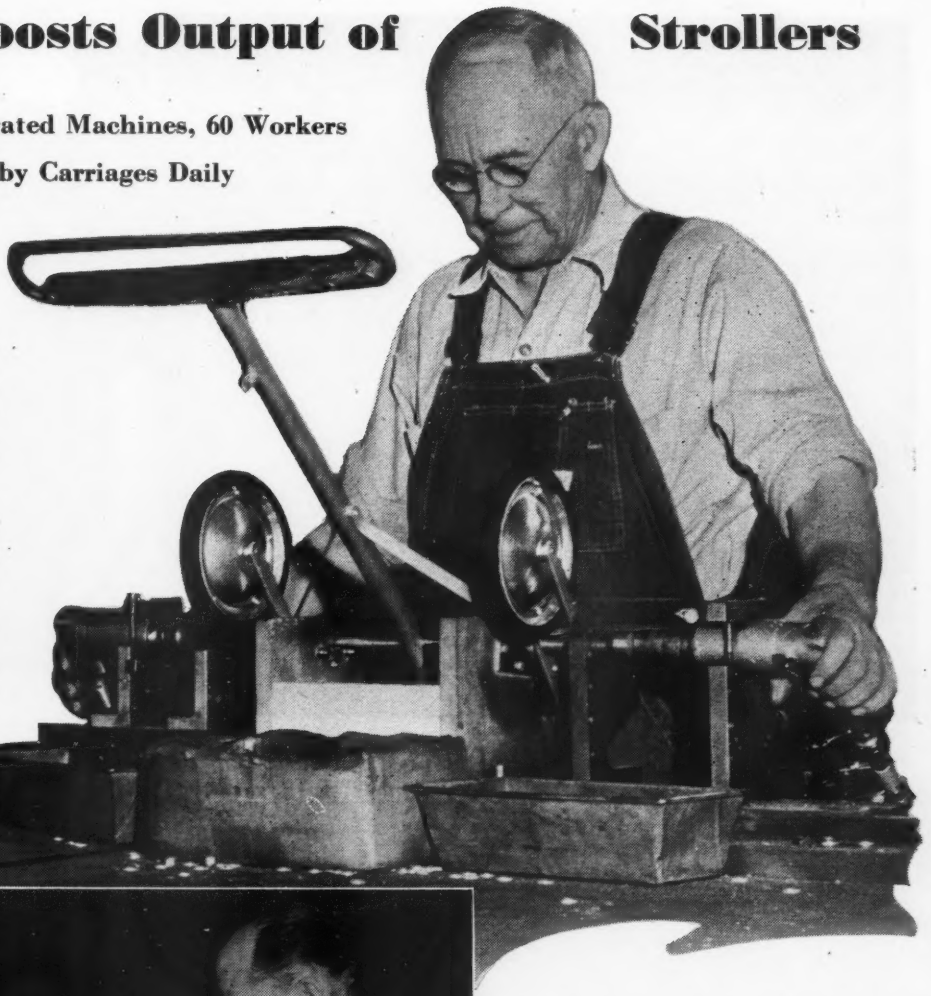
IN THE MERCHANT MILL

Small angles on a cooling bed. With the exception of pipe, the steel mill turns out substantially all products needed in the country.

Air Power Boosts Output of Strollers

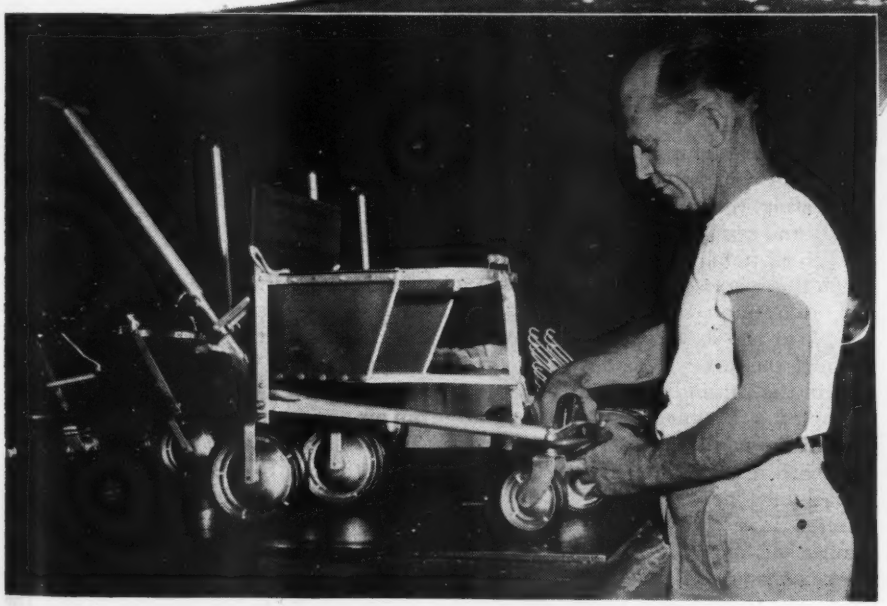
Using Pneumatically Operated Machines, 60 Workers Can Build 1000 Baby Carriages Daily

Philip Brenton



SIMPLE WITH AIR TOOLS

One end of the tubular backbone of the Folda-Rola fits into a hole in the front-axle-assembly casting and is secured to prevent turning by "dimpling" it into place. As formerly done with a pointed tool and hammer, this was a slow operation and broken castings were not unusual. Now, as shown below, a workman does the job quickly and easily with an air-powered pinching tool that is designed to exert the exact pressure needed. Using air wrenches, the man pictured at the right turns nuts simultaneously on both ends of a tie rod that runs above the rear wheels. With less exertion, he now performs the operation three times faster than when hand ratchet wrenches were enployed.



"WE USE compressed air extensively in our plant and have found that it yields many benefits," reports Arnold E. Peterson, president of A.E. Peterson Manufacturing Company, Glendale, Calif.

Actually, 75 percent of the machines in this modern factory are either run entirely by air or have air attachments. In the case of some particular operations the labor costs have been cut in half; in others the savings have been even greater. The plant has initiated a program of converting to air wherever possible, and Mr. Peterson estimates that its use has reduced production costs by at least 25 percent and accidents by 90 percent. Furthermore, substitution of air for manual power has resulted in a friendlier attitude of employees toward management—they like their work more than formerly because they can do it faster without physical effort. The economies effected through its widespread application have been so marked, according to Mr. Peterson, that the cost of the installation was amortized in about six months.

The company is unique in that its chief product is a lightweight folding stroller invented by the head of the company for his own use in 1945, when he gave up his prosperous contracting business to put it on the market. Soon the new plant, with an area of 7000 square feet, was turning out 100 units a day. Recently the demand exceeded its capacity, and Mr. Peterson built his present 20,000-square-foot factory. He now manufactures around 600 Folda-Rolas a day, as well as about 100 each of several companion products: the Folda-Twin, the Folda-Step for kitchen use, and the Folda-Rola car seat for babies. A 3-seater stroller for triplets is made simply by adding one seat to the Folda-Twin.

Compressed air is used at almost every step in the making of the folding stroller, from the fabrication of the various parts right through final assembly. Each of three punch presses, which range in capacity from 35 to 50 tons, is equipped with an air treadle to trip the hammer, and air blows the slugs out of the dies and extracts the finished part. "Since the operators do not have to place their hands underneath the dies at any time it is well-nigh impossible for them to be injured," states Thomas R. Harvey, plant foreman.

The backbone of the Folda-Rola is a shaft that runs from the front axle all the way up to the wooden handle. This shaft has to be bent, a job that formerly re-

EASY AND SAFE

Riveting two aluminum disks together to form a wheel was formerly done on a punch press that became justifiably known as the "finger chopper." Equipping it with air controls that trip the hammer when the work is in place and ejecting the piece after it has been riveted permits a girl (left) to work without hazard. She just places the disks on an inclined feed table and the machine then takes over. Bending tubular shafts into shape in a manual press used to tire even a husky man. Now, as illustrated at the right, a girl does the job with little exertion. Foot pressure on a treadle admits compressed air to a cylinder that substitutes smooth, positive power for muscular effort. Air power has made many other operations in the plant not only safer and easier but it has also increased production.

quired the services of a husky man working all day long on a manual press. And even a very strong man was "knocked out" at the end of the day. Now all the bending needed to meet the production schedule is done by a girl with an air-actuated machine in part of a day.

The shaft is made up of two tubes, one of steel and one of aluminum, so that it can be adjusted for persons of different heights. A special locknut pressing against the inside wall of the shaft holds the length firmly, as desired. Before the introduction of compressed air, two men were kept busy all day just drilling and tapping these flat nuts. Today, long strips are drilled and tapped on a part-time basis by air-operated presses equipped with pneumatic vises.

Because the shaft is hollow it is necessary to have a plug in the end to which the handle can be fastened. Drilling and tapping this plug once took a lot of time, but the work has been simplified through the medium of an air vise. The plug is quickly squeezed into the tube by an air press operated by a girl, a job which, if done by hand, would require a man. Another woman attaches the handle, using a screw driver actuated by a pneumatic tool. Except for air power, a man would also have to perform this work because a girl would not be strong enough to turn the screw all the way in. The other end of the shaft is fitted over the front castor assembly by an air press. Because the tubing has to be expanded and again contracted in getting it over the casting, the operation has to be done slowly and carefully. A manual press did the job all right, but the air press is easier on the operator and better in the long run, according to Mr. Peterson.

So that the shaft will not turn on the casting, the latter is made with a little hole in the top into which the tubing is "dimpled." Previously this was accomplished by pounding the tube into the hole with a chisel and hammer, a slow and clumsy procedure that frequently resulted in a broken casting after the stroller was partly assembled. Now the workman is provided with an air pincher which not only does a neater and more uniform job without breakage but also does it five times as fast as in the past.

The firm buys aluminum disks from which the wheels are made by riveting two together. This necessitates stamping holes in them, an operation which, under the old conditions, was dangerous because the girl at the machine had to place her hands under the dies to insert and to remove the disks. This punch press was known as the "finger chopper" in the plant until it was equipped with air controls that trip the hammer when the work is in place and blow the finished product down a chute. Now she merely lets the disk slide down an inclined plane onto the die, and the machine takes over. The result: a much faster and an entirely safe operation.

Compressed air has solved another of the firm's vexing problems and reduced it from an all-day to a part-time job. Both ends of the tie rod which goes above the rear wheels have to be turned down to a smaller dimension and then threaded to take a nut. This is now done by a drill press fitted with special cutters and with an air vise to hold the stock. The operation is synchronized—the worker just puts the rod in position with one hand and manipulates the feed with the other. Opening and closing of the vise is regulated by the hand feed, so that one control is eliminated. Now the ends are turned as fast as the man can move. The process is repeated for threading. "These are simple operations, but they formerly consumed a great deal of time," explains Mr. Peterson. Another job that has been speeded up is the turning of the nuts on the ends of the tie rods. Previously the worker tightened both simultaneously with ratchet wrenches, but now two air wrenches do the job for him about three times as fast and without any exertion on his part.

In the final assembly of the strollers extensive use is made of air-powered rivet squeezers. Riveting the undercarriage, for example, formerly called for the services of two girls. Now it is done

by one with the help of three squeezers of different size and one pneumatic wrench. She lines up a number of Folda-Rolas on a table and puts in all the rivets of one size, then changes the tool by means of quick-change couplings for the next size. A big labor saving is effected in this case not only through the conversion to air power but because it is no longer necessary to lift the strollers to do the work. The squeezers perform all the riveting in the plant, including fabrication of the wheels.

The wooden seat is hung from the frame by strips of canvas into which clean holes are punched by a pneumatic tool so that the screws and rivets will not get fouled in the threads. The Phillips screws that are utilized to fasten the canvas as well as the steel angle brackets to the seat are put in with an air-operated screw driver. Both these tools are also used in punching holes in fabric and driving screws and rivets in the manufacture of the company's car seat for babies. Spot welding of its metal parts has ceased to be a painstaking job since the application of compressed air, which enables the worker always to put the desired pressure on the tips. Once this has been ascertained, the operation is simply a matter of routine. In fabricating the Fold-A-Step the company uses squeezer guns for riveting, a pneumatic bench press for extracting slugs when holes are punched in the legs of the appliance, and an air-actuated press for gluing a piece of rubber on top of each tread.

NO BULGING MUSCLES NEEDED

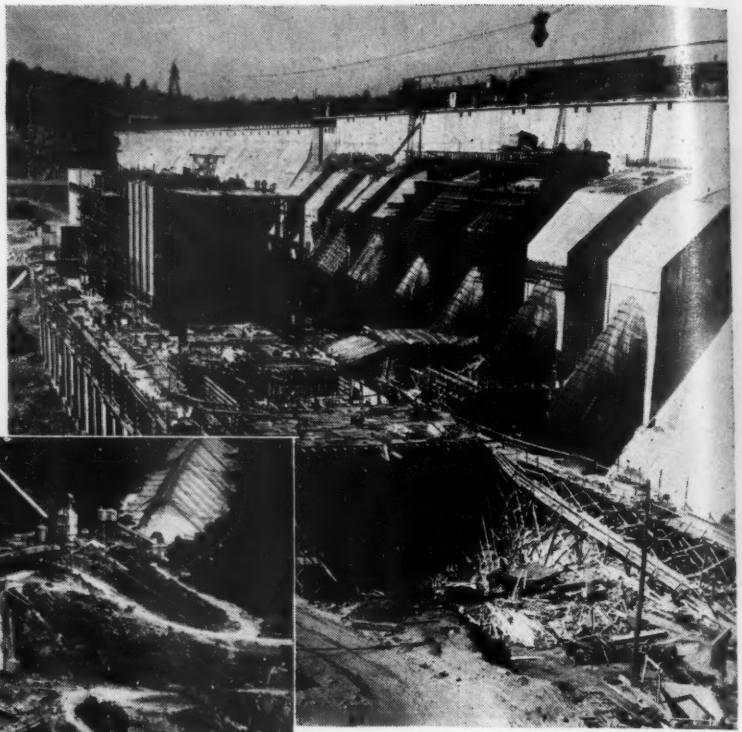
Inserting a screw to fasten the wooden handle to the end of the drawtube isn't a heavy job, but it formerly had to be done by a man. With an air-operated screw driver rigged up as shown at the top-left a girl performs the operation in jig time. Adding an air vise to a standard drill press speeded up turning down the ends of tie rods—a girl (top-right) inserting the pieces with one hand and working a single control lever with the other. Compressed air exerts even, positive pressure on electrode tips (above) to do the never-varying job of spot-welding in the assembly of car seats for babies.

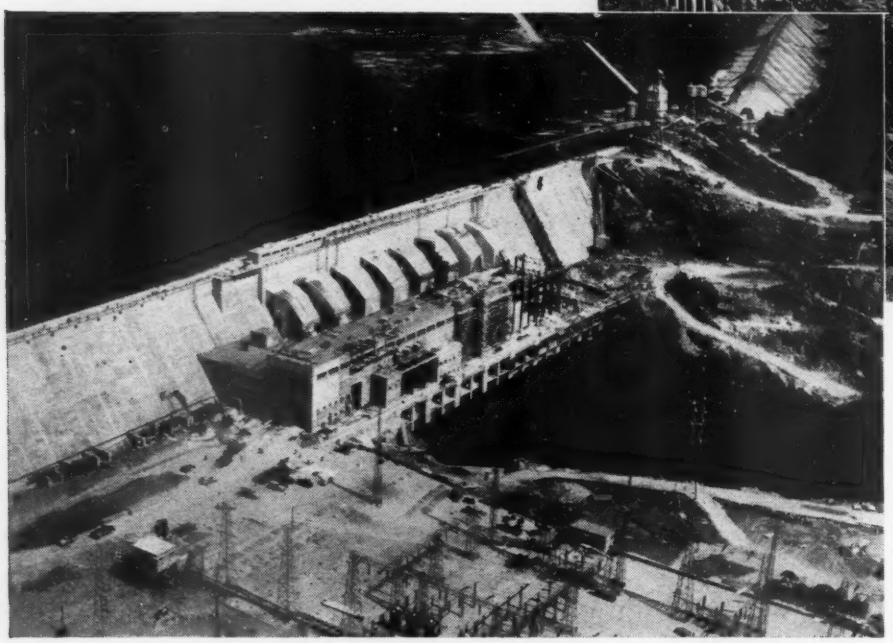
An interesting fact about the A.E. Peterson Company is that it wasn't even in existence five years ago, and now it is turning out between 600 and 700 strollers a day, largely through the change-over from hand to air power. With two compressors—a 7½- and a 10-hp. machine—supplying air at 140 psi. discharge pressure, and a working force of only 60, the plant has a maximum daily capacity of 1000 of these units, exclusive of its other products.

Ottawa River Power Development

Des Joachims Plant, Put in Service in June, Will Eventually Generate 480,000 Horsepower

W. M. Goodwin





HYDRO NEWS PHOTOS

MAIN DAM UNDER CONSTRUCTION

A section of the 2400-foot main dam, with water passing through the powerhouse and on out of the tailrace, is illustrated above. Power switching structures are in the foreground. At the far end of the dam is the concrete mixing plant, and beyond it are aggregate storage piles surmounted by a belt conveyor supported on A-frames made up of Bailey bridging. The upper picture shows the power plant under construction, with the eight 22-foot-diameter steel penstocks that will carry the water from the dam headworks to the turbines. The operating head is 130 feet.

NINE hydraulic and two steam plants, with a combined capacity of 1,614,000 hp., constitute Ontario Hydro-Electric Power Commission's postwar campaign of power development. Three of these eleven stations are on the Ottawa River and account for half of the energy. By far the largest of the latter group is the 480,000-hp. Des Joachims plant with which this article deals and which was officially put in service the end of June by Robert H. Saunders, chairman of the Commission. So far, two of its 60,000-hp. generating units are in operation, and the remaining six are to be brought in in sets of two at intervals of about six weeks.

The project has involved the construction of four dams—the main dam with powerhouse, an auxiliary dam, a side dam, and a flood-control dam—and is of more than common interest because of one unique and several unusual engineering features. It was completed at a cost of more than $75,775,000 six months ahead of schedule and, in the words of Mr. Saunders at the time of the opening ceremonies, "signifies the end of the power shortages in Ontario."

The village of Des Joachims (pronounced Dah Swisha by the local inhabitants) is a little old French settlement 136 miles upstream from Ottawa and 250 miles from Montreal. As was so often the case in the days long gone by, the voyageurs were induced to establish themselves there because the spot was at the end of a long portage. The surrounding territory was held for generations by a family named Joachim, hence the name, "Belonging to the Joachims." Except for the influx of construction workers, the village has largely the air and habits of a century ago. From it there is a lovely vista eastward along a quiet, lakelike stretch of the Ottawa called Deep River, which extends for 25 miles to Canada's atomic research plant at Chalk River.

Among the accompanying illustrations is a general layout of the scheme showing the Ottawa as it was and as it is with the backed-up waters forming a new lake approximately 57 miles long and up to 2 miles wide. It has been named Holden in honor of Dr. Otto Holden, Ontario Hydro's assistant general manager of engineering. It should be mentioned that all the designs and plans for the Commission's development projects are made by its own Engineering Department and, as a rule, are carried out by the Construction Department. However, at times of peak activity, as in the case of Des Joachims, some of the work is let out to contractors.

The main dam is a gravity-type concrete structure, 2400 feet long and 180 feet high above bedrock. Adjacent to and north of it, covering low spots on newly formed islands, are the auxiliary and side dams, the former having a length of 1300 feet and a maximum height of 50 feet. The flood-control dam is located at the upstream end of Mc Connell Lake and is 1600 feet long and 130 feet high. The main dam and powerhouse span what once were three islands near the head of former Des Joachims Rapids and have closed three channels of the Ottawa—the Ontario, the Interprovincial, and the Quebec.

Under ordinary circumstances the dam would have been placed at the foot of the rapids, but in this instance it was built at the head. This necessitated excavating a tailrace 7000 feet long and 175 feet wide, with a maximum depth of

HYDRO NEWS PHOTO

FLOOD-CONTROL DAM

This structure across the preglacial channel of the Ottawa River is 1600 feet long and 130 feet high. Its purpose is to discharge surplus water so that the tailrace below the powerhouse is required to handle only the flow through the turbines.

cut of 40 feet at the power plant. However, because of the lowness of the rock banks along the rapids, it was found that it would have cost considerably more to construct a long dam at the foot and wing dams upstream than to remove about 1,400,000 cubic yards of rock.

The sequence of the various operations had been planned not only for speed but also for economy. The main dam was built in sections by changing the course of the river from one natural channel to another. Later, when the tailrace was excavated, the water was run through McConnell Lake. The initial step was taken in the fall of 1946 and involved closing the Ontario Channel just south of the powerhouse site by erecting cofferdams up- and downstream and diverting the water mainly through the Interprovincial Channel to the north. The Ontario section of the main dam was then poured, leaving nine temporary openings or sluices each 40 feet wide and separated by piers 20 feet in width. These openings were designed to take the maximum flow of the Ottawa for the remainder of the construction period.

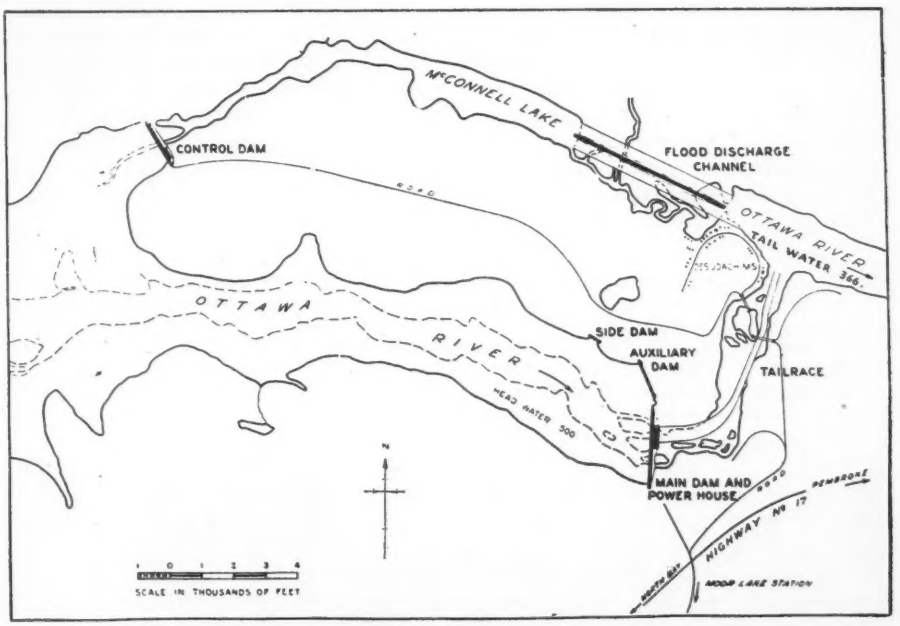
With the river passing through the nine diversion sluices, the powerhouse site was next unwatered by means of cofferdams, that section of the main dam was reared, the deep excavation for the hydroelectric plant was made, and the latter structure was started. Meantime the main dam was extended toward both banks of the stream, work on the auxiliary dam was undertaken, and the Atlas Construction Company began to build the McConnell Lake control dam. The latter, like the main dam, was constructed in the form of piers, leaving nine sluices of sufficient width to accommodate the river at flood stage. The purpose of the openings, high and dry above the Ottawa's former banks, will be explained later.

The unique feature of the project was brought into play in July of last year. Then the nine temporary openings in the main dam were filled with concrete to a point above the level of the control-dam sluices so as to divert the stream through McConnell Lake and permit excavating the tailrace. Closure of the openings through which the whole river was flowing called for some unusual measures.

Three steel gates had been provided, each consisting of a 50-ton frame to fit across the 40-foot opening and of five shutters to be dropped successively, side by side, within the frame. These shutters shut off the water much like stop logs, but under far more difficult conditions.

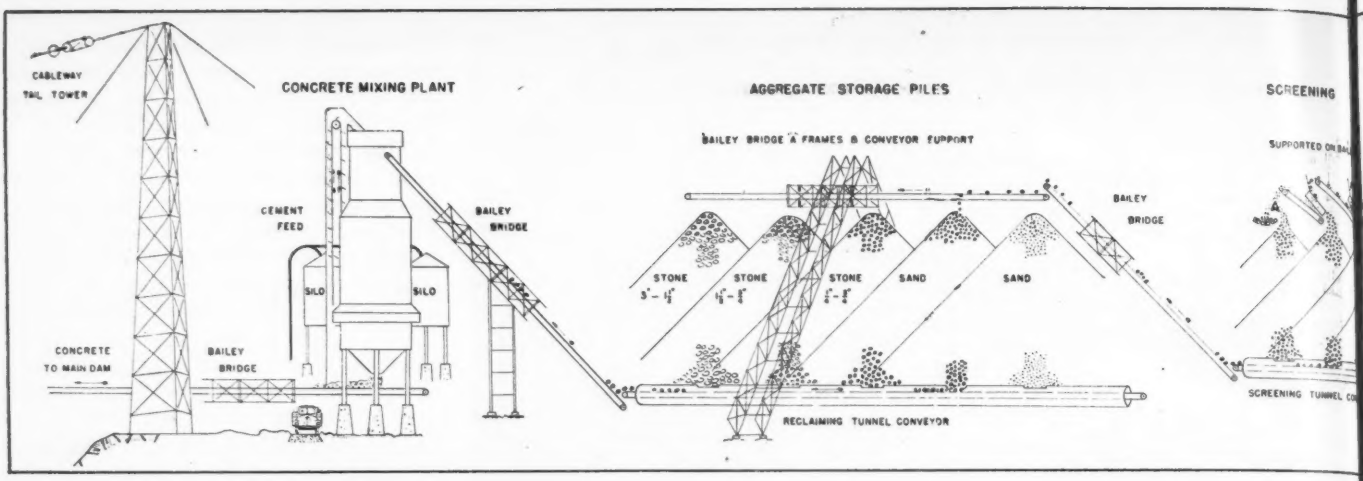
With a gate in position, concrete was placed behind it up to a certain elevation. Upon completion of the pour, the gate was transferred to the next sluice, and so on. By the middle of September, 1949, the last opening in the main dam was closed and the river was running through the temporary sluices of the control dam into McConnell Lake. Meanwhile, a cofferdam had been built across the river 7000 feet downstream from the powerhouse in readiness for the excavation of the tailrace in the dry.

At that time the reservoir level was only partially raised because some of the upper sections of the main dam and the headworks were not finished. But since last November, when the closure gates were moved to the control dam to start the same proceedings there, the huge headpond has been rising gradually, and the expectations are that the next spring runoff will fill it to capacity. It should be noted that only surplus water can be



PLAN OF DES JOACHIMS DEVELOPMENT

The river formerly followed the upper channel marked McConnell Lake, but shifted to the lower one at the end of the ice age, about 40,000 years ago, leaving a stretch of the old course high and dry. By incorporating the latter in the hydroelectric scheme as a flood-discharge channel, the job of construction was simplified and its cost reduced. The main dam was erected in two stages at the head of a series of rapids. The section south of the powerhouse was put in first, the river meanwhile being diverted by cofferdams. Next, the stream was routed through sluices left in the first section while the main dam was being completed, the powerhouse started, and the auxiliary, side, and control dams were built. Finally, the flow was diverted through sluices in the control dam into McConnell Lake so that the tailrace could be excavated in the dry.



AGGREGATE AND CONCRETE FLOW SHEET

Gravel obtained from a pit on the Quebec side of the river was crushed and then screened into sand and three sizes of stone, which were stockpiled for delivery to the concrete mixing plant as required. From the crusher the materials were transported on 30-inch belt conveyors supported on Bailey bridging. Mixed concrete was similarly carried to pouring points in the dam area. The drawing indicates the flow from crusher to dam. The 159-foot tail tower of the cableway that transported construction equipment and materials for a maximum distance of 2175 feet is at the left end.

thus impounded, because the normal flow is needed to operate the power plants downstream from Des Joachims.

The excavation of the tailrace was a big job and was divided into two sections by the commission: 550,000 cubic yards of rock to be removed by its own forces and 860,000 cubic yards by C. A. Pitts General Contractor Ltd., the latter at a cost of approximately two million dollars, including line drilling and dewatering of the area after closure of the main dam. The river bottom was very rough and jagged and was leveled by a large battery of Jackhamers preparatory to moving in three Quarrymasters, five power shovels, and twenty 15-ton diesel dump trucks. Subsequently, a fourth Quarrymaster was put to work. The big Caterpillar-mounted rock drills used 5½-inch-diameter, 4-point drill bits with tungsten-carbide inserts and put down holes as much as 55 feet deep. This necessitated lengthening the 35-foot steel stem.

The presence of a highway bridge across the lower end of the tailrace seemed to offer some difficulty because the piers were only 20 feet away from the sides of the cut. However, by careful line drilling on 1-foot centers along the substructure with wagon drills, and by setting off with short-period delay caps not more than two or three lightly loaded Quarrymaster drill holes in the area underneath the deck, the bridge was not damaged though no blasting mats were used.

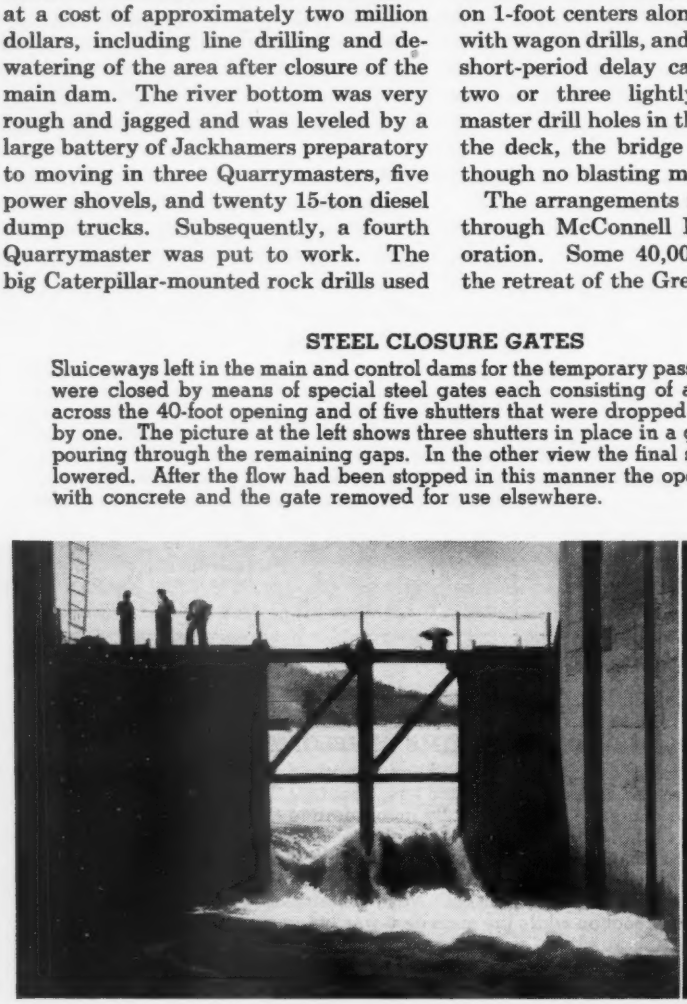
The arrangements for flood discharge through McConnell Lake deserve elaboration. Some 40,000 years ago, after the retreat of the Great Glacier, the Ottawa very likely flowed for a time through McConnell Lake. Then the erosive action of the Des Joachims Rapids caused the water to drop below the level of the rock barrier at the control-dam site, leaving it high and dry. So the level of the present reservoir is probably not much above that of the river as it was in the period immediately after the glacier's retreat.

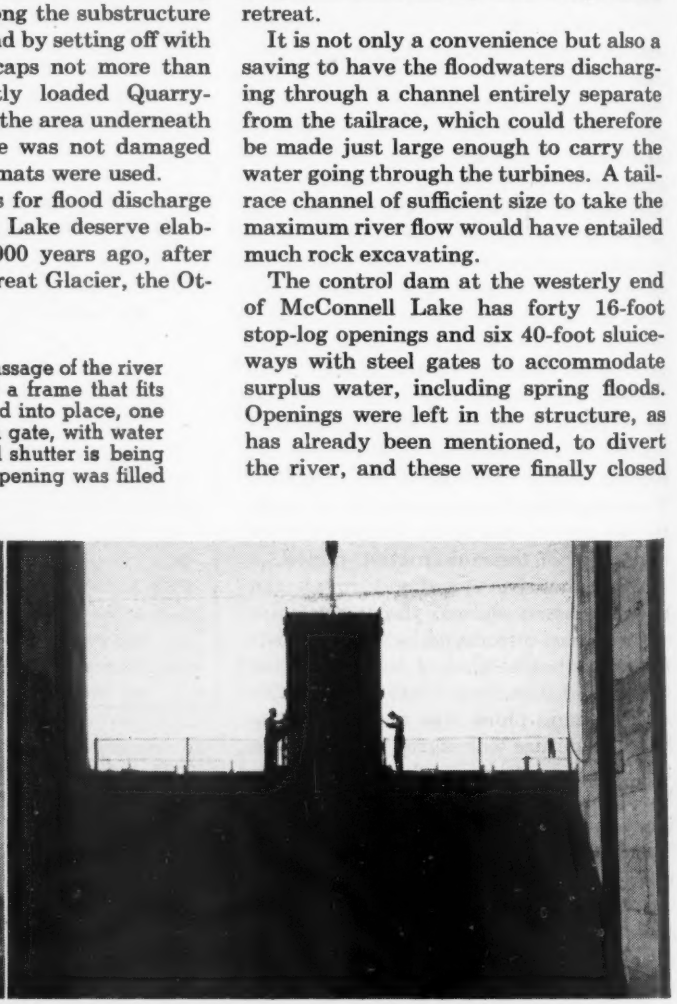
It is not only a convenience but also a saving to have the floodwaters discharging through a channel entirely separate from the tailrace, which could therefore be made just large enough to carry the water going through the turbines. A tailrace channel of sufficient size to take the maximum river flow would have entailed much rock excavating.

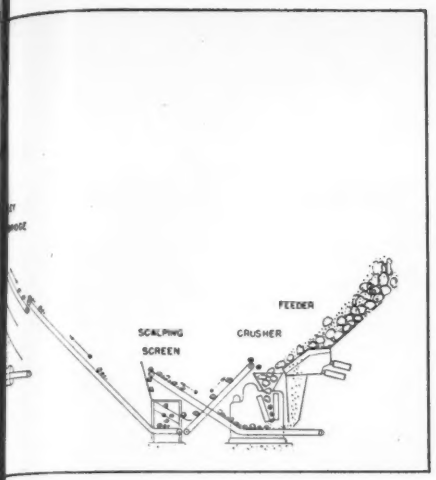
The control dam at the westerly end of McConnell Lake has forty 16-foot stop-log openings and six 40-foot sluiceways with steel gates to accommodate surplus water, including spring floods. Openings were left in the structure, as has already been mentioned, to divert the river, and these were finally closed

STEEL CLOSURE GATES

Sluiceways left in the main and control dams for the temporary passage of the river were closed by means of special steel gates each consisting of a frame that fits across the 40-foot opening and of five shutters that were dropped into place, one by one. The picture at the left shows three shutters in place in a gate, with water pouring through the remaining gaps. In the other view the final shutter is being lowered. After the flow had been stopped in this manner the opening was filled with concrete and the gate removed for use elsewhere.







by means of the special gates when the main dam had reached a certain height.

The natural discharge of McConnell Lake into Deep River was a small stream meandering through beds of gravel and sand. A straight trench was dug through the latter and it is expected that the first high water, probably next spring, will scour this channel to the size required. Protective works have been erected along the bank above the village of Des Joachims to forestall any danger of floods.

A large bank of clean gravel, found near the outlet of McConnell Lake and within sight of Des Joachims, provided all the necessary coarse and fine aggregates. It was crushed and screened on the site and carried by a series of 30-inch belt conveyors to stockpiles near the north end of the main dam. The conveyors were supported by Bailey-bridge units. Ontario Hydro had acquired a large supply of these adaptable structures from surplus Army stores and has used them for many purposes.

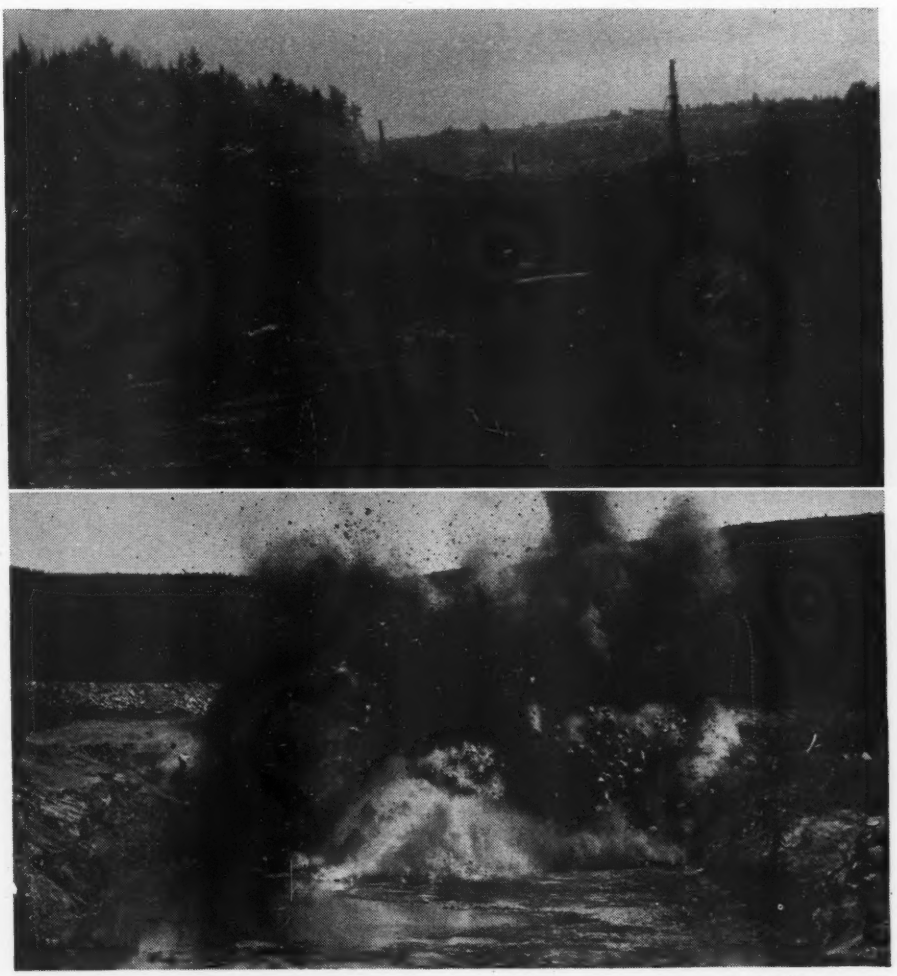
The concrete plant had served well on several previous jobs. With four 2-cubic-yard mixers fed batches proportioned automatically by weight, it was possible to deliver the material continuously to two 30-inch conveyor belts. The latter traveled above the main dam site in a gallery made of Bailey bridging resting on a Bailey-bridge trestle.

Another striking feature of the scene of operations during the construction period was the cableway over the main dam. This also had served to advantage on a number of similar jobs. The cable was supported by two towers 159 and 105 feet high, respectively. The former was stationary and guyed to rock anchors, while the other was mounted on a radial track and counterbalanced by a sand box. Loads were picked up at the latter end, and the movement of the tower permitted their delivery anywhere along the main dam or in the powerhouse area.

During peak activities more than 2500 were employed on the project, which called for the excavation of 3,596,000 cubic yards of rock and 2,344,000 cubic yards of earth. A considerable amount of this material was removed in connection with the relocation of 23 miles of railway and 12 miles of highways that were within the area to be inundated. The permanent structures necessitated the use of 880,000 cubic yards of concrete. A total of 5600 tons of steel was utilized, including the Bailey bridging, as well as some 18,000,000 board feet of lumber (equivalent to 720 carloads). Most of the latter was obtained in clearing 11,000 acres of land along both sides of the Ottawa for a distance of 57 miles upstream from the dam site and was used for forms for placing concrete, for camp buildings, and construction purposes. To complete the huge project within the allotted period, all possible time-saving mechanical aids were put into service.

When completed and running at capacity, the Des Joachims station will house eight 60,000-hp. Francis-type turbines operating under a head of 130 feet. Each will drive a generator rated at 50,000-kva. at 90 percent power factor and produce 60-cycle current at a potential of 13,800 volts. There will be four banks of three transformers and one spare, or a total of thirteen transformers each of which will have a rated output of 33,333 kva. at 230,000 volts. Installation of the latter facilities and the construction of the transmission line to be tied in with the Southern Ontario System are well advanced.

Power will be transmitted at 230,000 volts to transformer stations at Kipling (Toronto), Burlington (Hamilton), and Westminster (London), at which points it will be stepped down to 115,000 volts to supply the Niagara division of the provincial hydroelectric system.



HYDRO NEWS PHOTOS

FINAL TAILRACE BLAST

Nearly 1,500,000 cubic yards of rock, weighing some 3,000,000 tons, was excavated from the tailrace—a channel 7000 feet long, 175 feet wide, and 40 feet in maximum depth. Much of the drilling was done with Ingersoll-Rand Quarrymasters—large, self-contained portable machines that carry their own compressed-air plant and put down 5½-inch-diameter holes to depths of 35 feet. Three of them are seen at work in the upper view. They were operated by C. A. Pitts General Contractor Ltd., which carried out this work jointly with forces of the Ontario Hydro-Electric Commission. From five to ten Ingersoll-Rand wagon drills were used to put down 2-inch holes, while J-55 Jackhamers helped to break up large boulders resulting from blasting. All these machines were provided with Carset (tungsten-carbide insert) bits. The bottom picture shows the final shot that removed the last barrier between the lower end of the tailrace and the river channel downstream from McConnell Lake. It took 32,500 pounds of Forcite, supplied by Canadian Industries Limited, to break up approximately 60,000 tons of rock.

Arizona's Timber

Extensive Ponderosa Pine Forests Foster Thriving Lumber Industry that Turns Out Electricity as a By-product

John L. Parker

LOGS, LUMBER, AND SNOW
Below– An aerial view of Saginaw & Manistee Lumber Company's log pond, sawmill, and box factory on the edge of Flagstaff.
Left– Decked logs surrounding Southwest Lumber Company's pond at Flagstaff, with snow-capped Mt. Francisco in the background.
Above– Winter comes to the Arizona highlands with a vengeance, and last year 15 feet of snow fell at Flagstaff. The picture shows stacks of sawed lumber at Southwest's mill.

CONTRARY to prevailing opinion, trees thrive as well in Arizona as do cacti, and they are probably much greener than any that grow in Brooklyn. In fact, they are so plentiful that, even though the state produced nearly 200 million board feet of finished lumber last year, it still has the largest forests of virgin Ponderosa pine in the United States.

Lumbering is confined to the northern half of Arizona, with the biggest stands in Apache County on Indian and Government lands surrounding the San Carlos Indian Reservation, which takes in a big chunk of the state along the New Mexico border. Headquarters for this area centers around McNary, Ariz. Additional state and national pine forests are found in Navajo and Coconino counties. Logging activities there extend from the summer-resort town of Flagstaff on Highway 66 directly south to the great Mogollon Rim, the almost vertical escarpment of rock which divides the high timber and grassland plateau of northern Arizona from the hot desert and irrigated lowlands of the southern section 5000 feet below.

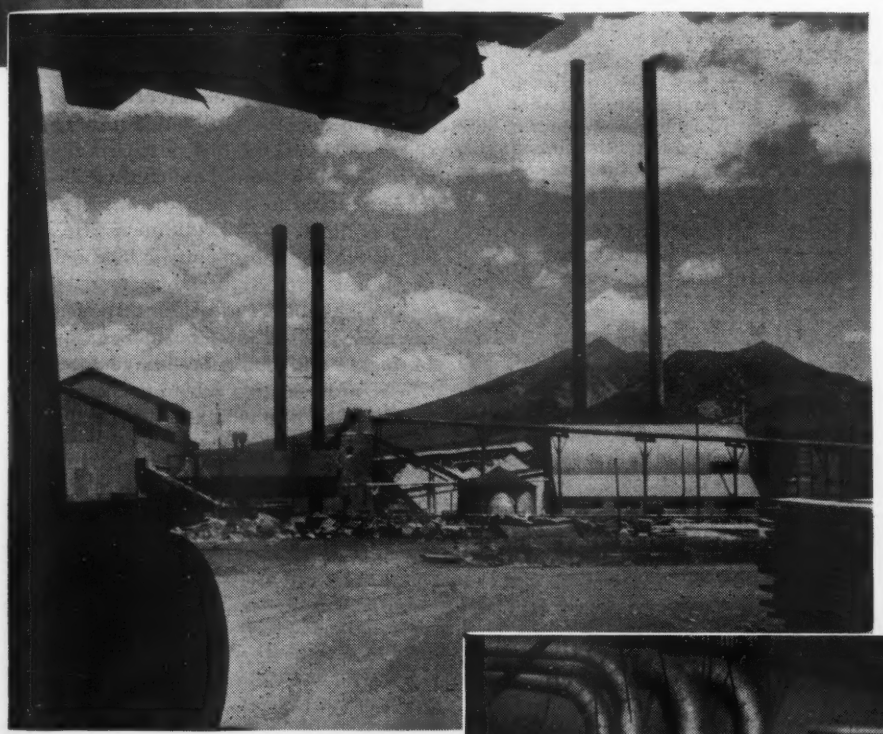
As might be expected of an industry squeezed into such a small area, logging and lumbering are well mechanized and completely integrated. Harvesting is carried on continually and according to the most advanced silviculture. The bulk of production is confined to the Southwest Lumber Company, with its main plant at McNary and other units at Overgaard and Flagstaff, and to the Saginaw & Manistee Lumber Company, with a sawmill and box factory at Flagstaff and logging operations in various parts of Coconino County.

Perhaps the most remarkable evidence of Arizona's progress in the lumbering industry is the complete absence of the huge waste-burning smokestacks generally associated with sawmills. In Arizona, where sufficient water to develop electricity is mighty scarce and coal is nonexistent, power production has taken

longed shutdown of the mills. Power generated at McNary is used by that company-owned town of 3000 and is sent over lines of the largest Rural Electric Co-Operative in the Southwest to farms and communities in a large section of northeastern Arizona and a part of New Mexico. By means of a newly constructed transmission line it is also carried over the statewide Central Arizona Light & Power Company system to Show Low.

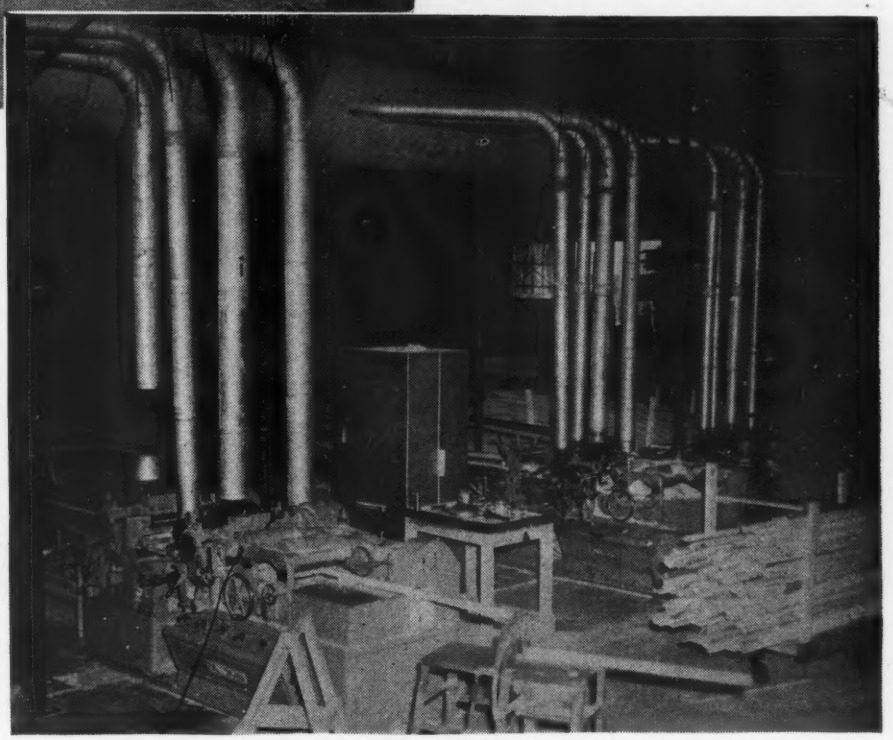
Recently, Southwest mills completed five years of expansion, which involved the creation of a new logging camp and the extension of its Apache Railroad from McNary some 70 miles over two 9000-foot mountain passes. The project cost nearly two million dollars and will supply the McNary plant with lumber in the foreseeable future. The logging camp, called Maverick, is situated in the heart of the Apache Indian Reservation that stretches along the eastern edge of the state.

As logs arriving from the forests are pushed from reinforced flatcars into a big pond capable of holding five million feet, the production cycle of the raw material begins. Sawmilling practices at the Saginaw & Manistee and at the Southwest Lumber Company plants are almost identical, so the following description applies to both of them. The logs are hauled out of the water by endless chains fitted with sharp teeth just long enough to snag the rough bark and lift the tree trunks to the second floor of the mill. As they leave the chain, they pass a swing saw which cuts to length any that are too long to drop readily onto carriages feeding big 6- and 8-foot band saws. Contrary to the general impression, it is the saw which remains stationary; the log on the swiftly moving carriage, on which the blocksetter rides, is rushed past the blur of revolving steel which slices it into lumber at a rate up to 20,000 feet per hour.



POWER FROM WASTE

Southwest's molding factory at McNary, claimed to be the world's largest, turns out shapes ranging from hoe handles to slats for Venetian blinds, and ships most of them east of the Mississippi River. Scraps and wood dust from the cutting machines, below, are drawn off through pipes and added to waste from other operations to be burned under boilers to produce electricity. Southwest's new generating station at Flagstaff, left, soon to be taken over by Central Arizona Light & Power Company, has two 750-hp. boilers that feed steam to a 3000-kw. turbo-generator.



to the woods in a big way. Every particle of a log that isn't used to make lumber, including the bark, is converted into fuel by grinding and fed to the fireboxes of three huge steam plants generating electricity. Two of these were until recently operated by Southwest Lumber at Mc Nary and Flagstaff but are about to be sold to Central Arizona Light & Power Company. The third is maintained by Saginaw & Manistee at Flagstaff. The plants never stop—they feed urgently needed juice into transmission lines 24 hours a day. The mills themselves, even when they are running at full capacity, use only about 11 percent of the power produced.

Current from the two stations at Flagstaff is delivered as far away as Phoenix. In order to insure continuous operation, the plants are equipped with oil-burning jets that can be cut in during any pro-

The sawyer must be able to make instant decisions, for each log presents a new problem. He has only a moment or so to make up his mind how to handle it before it rolls down onto the carriage to be levered by him into the desired position. There, powerful dog-toothed arms seize it and hold it immovable during its rapid pass through the saw. First one side is slabbed; then the log is rolled over 90 degrees and another side is slabbed. This operation is repeated until the timber is rectangular in form and ready to be cut into boards or other cross sections. Picking up the heavy wet logs, each weighing tons, is done by huge steam-powered arms with finger-tip controls that are conveniently placed in the sawyer's pit.

The swift gripping and holding power of the wedge-type teeth, called trimmer air dogs, is obtained through the use of compressed air. At the McNary mill the air for this key operation is supplied by a 140-cfm., belt-driven Ingersoll-Rand machine. Similar I-R installations serve the same purpose at Southwest's and Saginaw & Manistee's Flagstaff mills. Because of the effectiveness of compressed air in this amazingly high-speed work, as much as a million board feet of lumber will not vary a fraction of an inch.

Lumber comes from the saw full size and is cut into maximum standard lengths by automatic edging saws farther along the endless chains that move the boards through the mill. After seasoning, this rough-cut material requires further finishing in the planing mill, where it is smoothed to various grades down to fine satin sanding on both sides. Shrinkage in the drying kilns, plus planing and sanding, reduce the thickness of a one-inch board to $^{25}/_{32}$ inch.

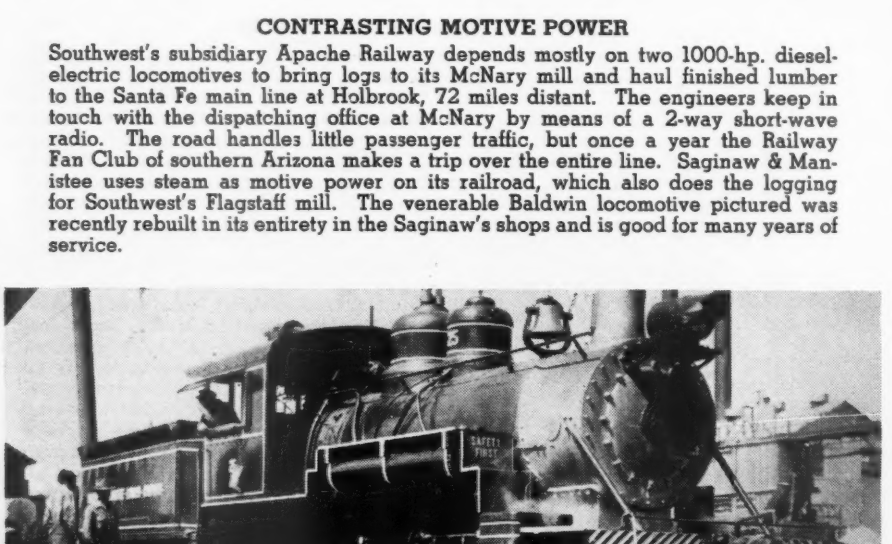
The most interesting part of the operations at McNary is the manufacture of molding. The plant was burned to the ground in June, 1948, and rebuilt in less than a year. It is housed in a 180x300-foot fireproof structure, with railroad-car loading facilities inside, and is said to be not only the world's largest but also to be situated at a higher elevation than any other of its kind. Lying at an altitude of 7300 feet, the mill is actually above the timber line of some of the other western states, although trees that are suitable for commercial purposes grow more than 10,000 feet above sea level in Arizona.

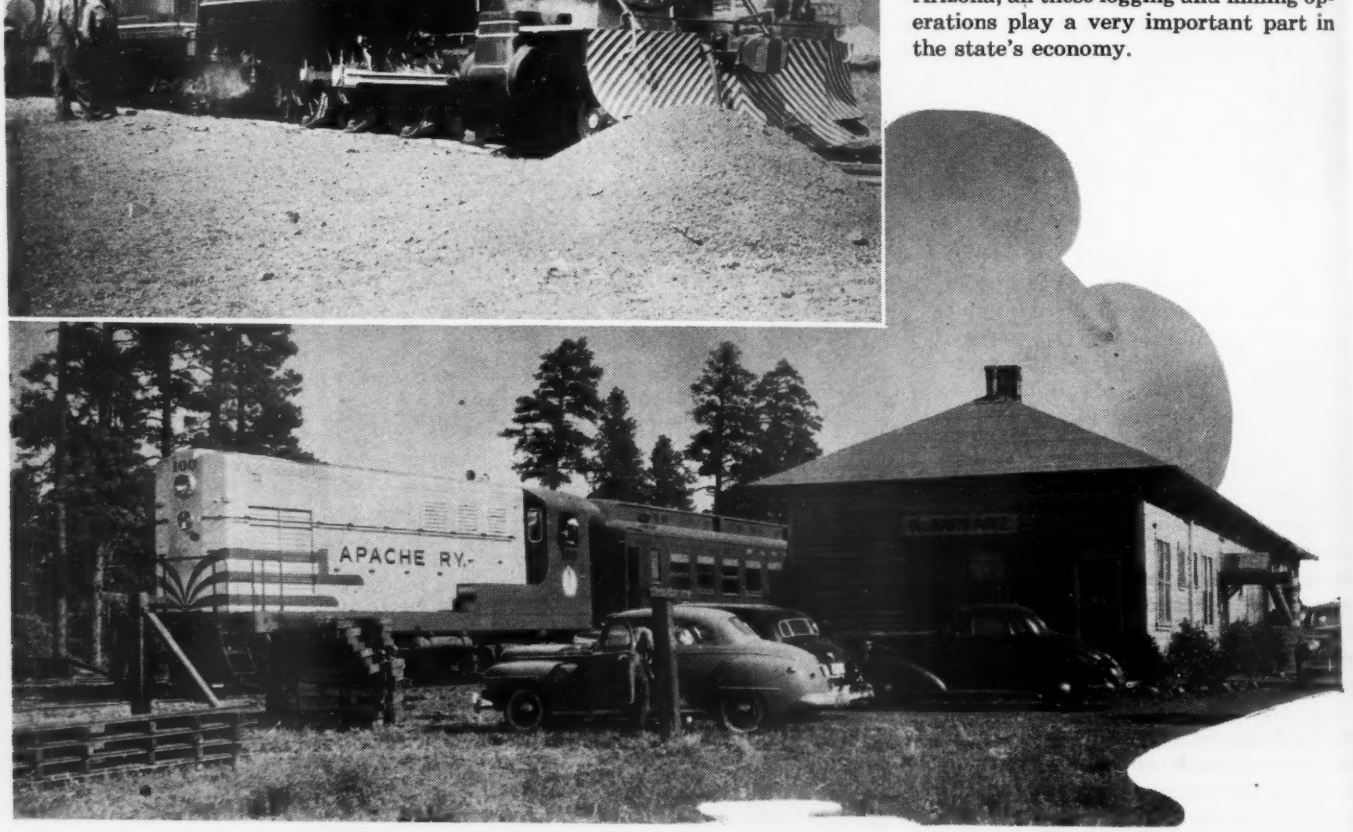
The best grade of lumber is used in the plant, and a bank of ten machines is capable of turning out anything from house molding of every kind to round hoe handles, Venetian blinds, and stair banisters. The patterns for the molding are made in a well-equipped shop, which also grinds the knives that do the cutting. Southwest Lumber Company ships 350 carloads of molding a year. Some of them hold as much as 500,000 linear feet, and 70 percent of the output is sold east of the Mississippi River.

At Flagstaff, in addition to the regular sawmill production, both Saginaw & Manistee and Southwest have factories where lumber of a lower grade is converted into apple boxes and vegetable and citrus-fruit crates used in picking and shipping the produce to market. Spread over much of the upper half of Arizona, all these logging and milling operations play a very important part in the state's economy.

CONTRASTING MOTIVE POWER

Southwest's subsidiary Apache Railway depends mostly on two 1000-hp. diesel-electric locomotives to bring logs to its McNary mill and haul finished lumber to the Santa Fe main line at Holbrook, 72 miles distant. The engineers keep in touch with the dispatching office at McNary by means of a 2-way short-wave radio. The road handles little passenger traffic, but once a year the Railway Fan Club of southern Arizona makes a trip over the entire line. Saginaw & Manistee uses steam as motive power on its railroad, which also does the logging for Southwest's Flagstaff mill. The venerable Baldwin locomotive pictured was recently rebuilt in its entirety in the Saginaw's shops and is good for many years of service.





New Diesel Whistle Simulates Sound of Steam Choo Choo

AS EVERYONE knows, the diesel locomotive is fast supplanting the venerable steam-powered iron horse. Wherever diesel power has taken over, rail travelers get places faster than they used to, more trains run on time, and all of them operate at a lower cost per ton or passenger-mile. These things are pleasing to the railroads and the public alike. About the only discordant note in the transportation transformation emanates from the diesels' horns. And now even that offending tonal effect is being remedied by replacing the horn with an "Airchime" that duplicates the familiar sound of the old steam locomotive's warning whistle.

Manufacturers of the sleek new diesels didn't wilfully discard the conventional whistle. They adopted an air-blown horn because they no longer had steam available to do the tooting. People living along dieselized railroads didn't like the blast and became vociferous in their objections. One woman likened it to "the mating call of a billygoat," and a man compared it to "the cry of a catamount whose appendix had been taken out without anaesthetic." Furthermore, many people charged that the horn didn't sound like a railway locomotive approaching a crossing and was dangerous because the signal could easily be confused with that of a truck or bus, or, in some areas, even with that of a boat.

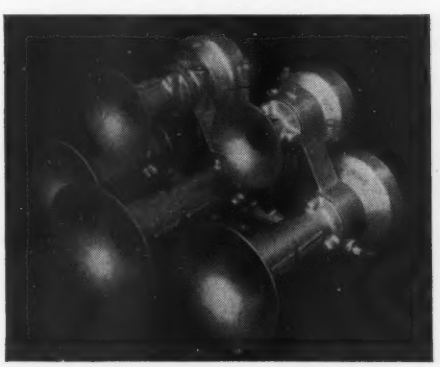
The railroads set out to do something about the mounting complaints, but weren't getting very far until Robert E. Swanson, a Canadian, approached the problem from a scientific angle. Safety officials of Canadian lines called the diesel horns entirely inadequate for their intended job and would not approve them. Swanson, chief inspector of railways in the Province of British Columbia, was assigned to investigate the effectiveness of warning devices at railroad crossings. The facilities of the province's research council were placed at his disposal and he was instructed to "conduct a thorough research into the harmonics of the old steam whistle and if possible to produce a new warning device for diesel locomotives that would retain all the characteristics and qualities of the old steam whistle and be just as loud." He was well fitted for the task because, for 25 years, he had been designing and making locomotive and steamboat whistles that were chordant and musical.

His first step was to record the note of the conventional steam whistle so that it could be analyzed. A wire recorder was set up in an automobile, and because ground-level noises interfered with the recordings they were taken at night as mighty Canadian Pacific locomotives thundered through the Rockies. When Swanson fed the recordings through a laboratory oscilloscope, the sound was found to be so complex that it was necessary to photograph the screen of the "scope" to stop and record the pattern. Experts who scanned the record concluded that nothing but a whistle would ever sound like a whistle. Swanson's problem then became one of finding out how to blow a whistle on a diesel locomotive that had no steam.

He discovered that the note of the whistle was made up of a series of fundamental notes with third, fifth, and seventh harmonics superimposed upon the fundamentals, comprising a musical chord of a certain general pattern peculiar to the locomotive whistle. He next recorded the sounds of various air horns on the market to see if a combination of them would produce the desired sound pattern. These experiments seemed to corroborate what the experts had said: that horns couldn't be made to sound like whistles and that their loudness couldn't be varied to reproduce the characteristic "wail" of a locomotive whistle.

Swanson was convinced that ordinary horns wouldn't do the trick. But he decided that, if a Hammond organ could simulate a pipe organ, a set of horns could be made to sound like a whistle. It was a matter of combining fundamental notes and superimposing the proper harmonics—simply a mechanical problem. He designed a horn of special shape with a multiple diaphragm operated by compressed air. Its note was recorded, and changes were made until the frequency of pitch as well as the harmonics were such as to give the desired sound. When this was accomplished, six horns, each with the proper fundamentals and harmonics, were put together in such a way that their combined sound would spread and level out like that of the steam whistle.

When the new "hexatone," as it was called, was placed in service on an electric locomotive in Vancouver and blown with air at 100 psi. pressure fed through a pipe only ½ inch in diameter, brakemen quivered and thought a big C.P.R. steam engine had somehow got in the yards where only electric power was supposed to be used. Next the device was tried out on a C.P.R. diesel locomotive on Vancouver Island and recorded by a sound truck. Commenting on the result, the engineer said that the sound was much like that of the traditional steam whistle, but a trifle more musical, a bit louder, and not so hard on the ears.



NATHAN 5-TONE WHISTLE

Finally, experiments were conducted to determine if the same effect could be obtained with fewer notes. A 5-horn unit of new design was built, tested, and proved to be satisfactory and less of an air consumer. A 3-tone model was also tried, but railroaders preferred the former, which was called Airchime because it had a pleasant chimelike tone and was operated with air under pressure.

Having completed his pioneer work, Swanson asked the Nathan Manufacturing Company, a New York concern that has been making steam whistles for more than 50 years, if it was interested in his development. In view of the clamor in the states against the strident diesel horns in general use, Nathan was quick to procure the rights to manufacture the new product. It has made some refinements in the Airchime and is now turning it out in large numbers. One by one the nation's railways have been adopting it, including the Lehigh Valley, Baltimore & Ohio, Louisville & Nashville, and the Southern.

The Nathan literature describes the Airchime as basically a musical instrument that operates on the flute principle. Each of the several individual tones is produced by vibrating a circular diaphragm (or reed) with compressed air to propagate sound waves. The pitch or frequency of the tone is determined by the size of the bell and the natural period of vibration of the diaphragm. "The flute type of sound propagation," it is stated, "produces a tone relatively pure or free of harmonics other than those inherent overtones which are octaves of the fundamental tone. It is this tonal quality which gives the steam whistle its characteristic sound, and this tonal quality must be built in when designing a different means of propagating sound waves to simulate the steam whistle."

R. H. Jenkins, Nathan's vice-president, points out that the sound of the Airchime can be softened whenever desired by means of a specially designed valve. "This," he says, "is a desirable feature when a train is passing through a residential area late at night and at other times when the engineer knows that loud tooting would be objectionable." With the start that has been made and the favorable reception from the public, Jenkins predicts that it will not be long until all diesels are equipped with Airchimes.

Modern Pumps Cut Mine Operating Costs

THE industrial slogan of the day is "Cut Operating Costs." In mines, manufacturing plants, refineries—wherever anything is made—the drive against rising production costs is becoming increasingly intensified. The answer to the big question, "Where to look first for ways to reduce costs," has been pretty well established. Since labor and materials prices are rather rigidly fixed, improvements in methods and equipment offer the best opportunities for lowering costs. As a consequence, they are being closely studied in all types of operations.

Inasmuch as a considerable share of our productivity depends upon the movement of all kinds of liquids, pumping equipment has become a major item of investigation by cost-conscious management, and for good reasons, too. In many industries, the electric power required to drive pumps represents a sizable percentage of over-all operating expenses. Consider, for example, the difference in power cost between a pump that is perhaps 25 years old and operates at 68 percent efficiency and a modern unit rated at 86 percent efficiency. A typical case of this kind came to light when the Sullivan Mining Company retired two pumps that had been in service on the 1200-foot level of its Star Mine in Idaho for 27 years and replaced them with modern Ingersoll-Rand RT-type units. Immediately, the monthly power bill dropped from $1100 to $800—a saving of $3600 a year in power consumption alone.

Hundreds of other instances where new pump installations have produced worth-while savings could be unearthed by an industrial canvass. The following example is presented in tabular form to show the contrast between a new and an old unit. The service concerned is the handling of 2000 gpm. of water at a total head of 185 feet.

	Year of Installation	
	1928	1949
Pump symbol	10-DV	6-ALV
Rpm.	1750	1750
Pump efficiency	71%	85%
Brake hp.	132	110
Electric hp.	156	129

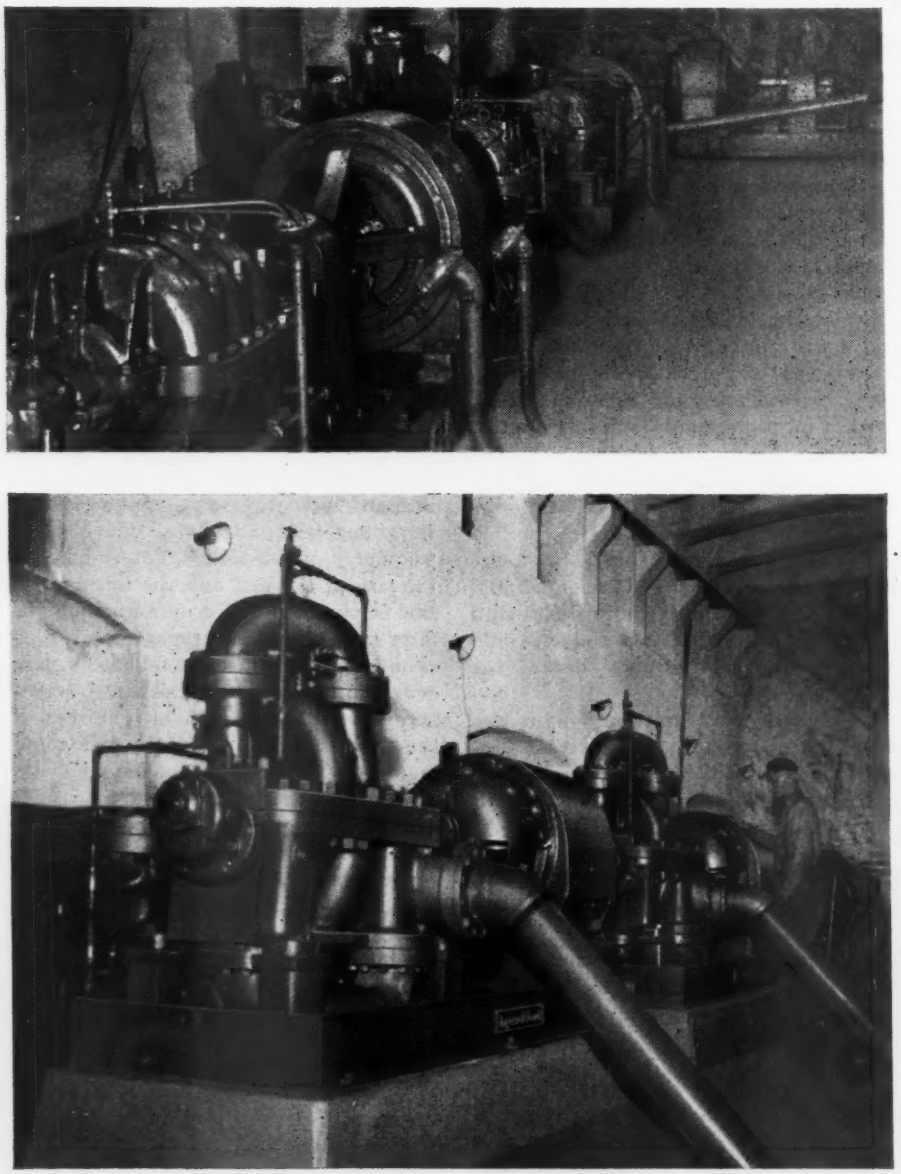
The resultant saving in power is 27 hp., or 20.2 kw. With current costing 1.5 cents per kilowatt-hour, it amounts to 30.3 cents an hour or, for a 5000-hour operating year, to $1515 annually.

An interesting interpretation that can be given such savings is that they are actually equivalent to underwriting sizable investments. Take, for instance, the $3600 annual reduction in power cost cited in the case of the Star Mine. A little figuring will show that, to obtain this sum every year from an investment yielding a return of 6 percent compounded semiannually, it would be necessary to put up $59,200. However, the price of the pumps, including motors and auxiliary equipment, that bring about this economy is only $11,400. On this basis, the pumps netted a profit amounting to the difference between $59,200 and $11,400—$47,800. Another way of looking at it is that the saving in power cost alone returns the cost of the pumping equipment every 38 months.

Excessive maintenance of pumping equipment also can be responsible for heavy operating costs. Aside from the high price of labor, consider what may be the loss in production while repairs are being made. Then, too, it is difficult, or sometimes impossible, to obtain spare parts for old pumps. Manufacturers cannot indefinitely maintain complete stocks for all the old pumps they have built and, therefore, replacement parts may have to be "tailor-made"—an expensive, time-consuming operation.

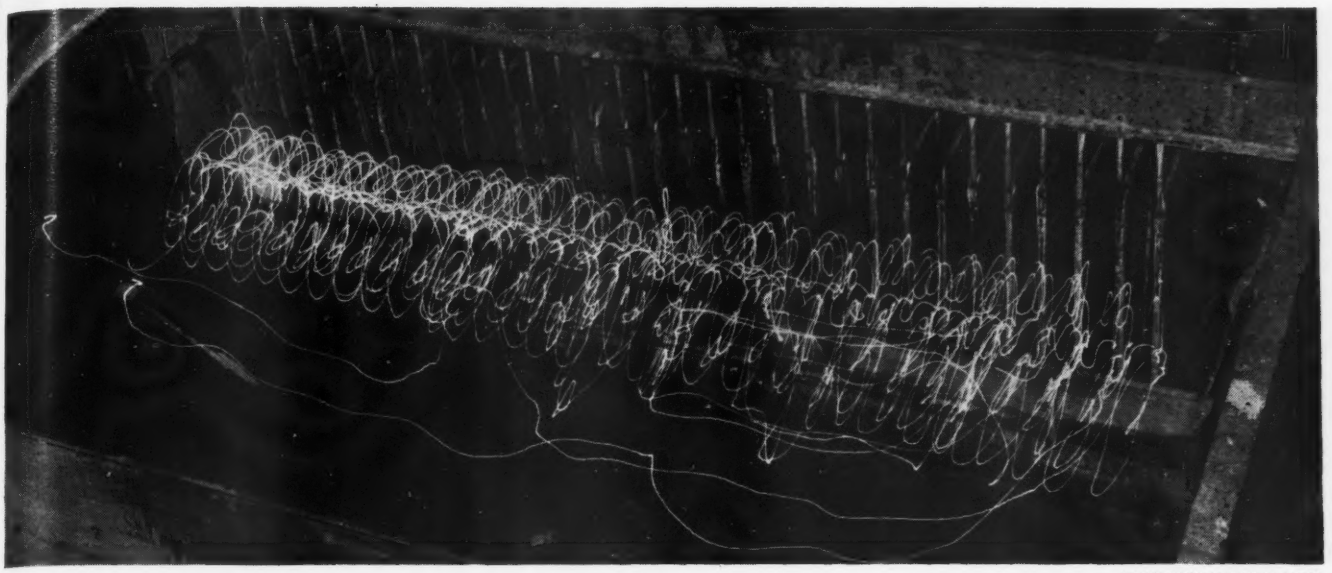
Is the pump suited to the job? New developments in methods and processes have antiquated many pumps. Production can seriously suffer because of excessive down-time brought on by pumps that can no longer keep pace with modern high-speed processes.

Pump manufacturers, in general, have done an excellent job in enlarging and improving their lines to meet industry's present requirements. New, more durable materials are being used to increase service life, efficiencies have taken a healthy upward swing, and over-all designs have been simplified to permit greater accessibility. It is apparent that industry can depend upon pump builders to provide it with equipment to help win its war on high operating costs.



OLD AND NEW PUMPS

By replacing 27-year-old units (top picture) with more efficient modern ones, the Star Mine in Idaho reduced its power bill by $300 a month.



KEYSTONE PICTURES INC.

A CONTRAST IN MOTIONS

To remove sticky pigment from a frame with a paddle, a worker's hands formerly had to describe the maze of motions indicated by the white lines in the picture above. By substituting a compressed-air jet to blow the pigment off, the hand movements were reduced to the simple pattern shown in the view below.

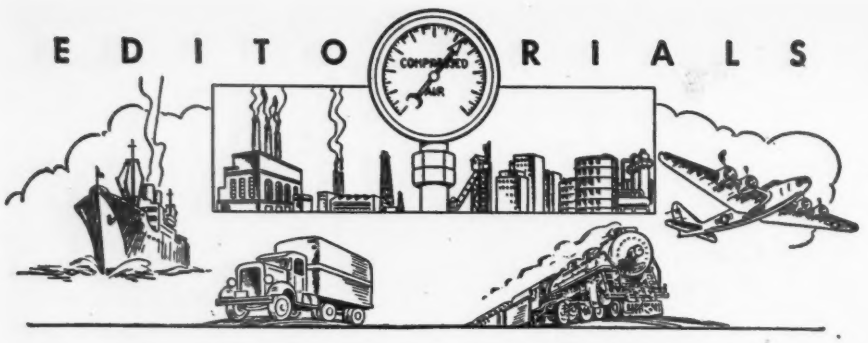
Lines of Light Trace Wasted Effort

PHOTOGRAPHS that trace the paths followed by the hands of workers as they perform various operations are being used effectively by duPont efficiency engineers in devising simpler and less costly ways of doing the things studied. One instance of this kind, a method that was greatly improved by substituting compressed air for hand labor, is illustrated in the accompanying pictures.

The technique by which the photographs are obtained is relatively simple, but was arrived at only after a great deal of planning and experimenting. Tiny lightweight flashlights are fastened to the wrists of a worker, who is then told to perform his allotted task in the usual manner. As he works, a camera stationed at a suitable vantage point takes a long-exposure photograph. On a print made from the developed film the movements of his hands appear as white lines.

The pictures in themselves do not solve the problem, although they sometimes suggest a solution. More often they form the basis for analyses of the portrayed motions and are supplemented with time and method studies. They are useful, too, in gaining the coöperation of workers brought under observation. When unnecessary movements are pointed out to employees, they are generally willing to try to eliminate them and thus reduce fatigue.

A comparsion of the patterns described by the white lines in the photographs reproduced here makes it easy to see how greatly the operation involved was simplified by changing the procedure. The equipment is a 31-leaf frame used in processing pigment in the duPont plant at Edge Moor, N. J. The frame has to be cleaned periodically, and this was formerly done by hand scraping with a wooden paddle. That this was a long and laborious job is evidenced by the snarl of white lines in the picture at the top. After due consideration, an engineer suggested that the pigment could perhaps be blown off with compressed air. A trial proved that he was right. Now the worker's hands go through the simple motions outlined in the picture at the bottom. What had been a tiring half-hour job was reduced to an easy one, taking only a few minutes. Obviously, the frame is now ready for reuse much sooner than it was before, and the operator has more time for other duties.



A DECLINING ART

THE winning single-jacker in a recent hand-drilling contest at Tonopah, Nev., drilled 10 1/16 inches in granite in ten minutes, and the leading double-jack team registered 15 1/16 inches. Without any intention of belittling the efforts of these hammer wielders, we venture the opinion that their performances wouldn't have placed in the money (of which there was plenty) a few years ago when every western mining camp of consequence staged a drilling competition as the main feature of holiday celebrations.

In 1903, at Bisbee, Ariz., Fred Yockey won the "singles" by sinking his keen-edged steels 26 5/8 inches in fifteen minutes, and the team of Carl Maka and Ed Chamberlain put down a 46 5/8-inch hole in the same time. Both marks were achieved in Gunnison (Colorado) granite, which was standard rock for these events. Even better records were made in other varieties of granite.

Assuming that the 1950 winners at Tonopah could have maintained the pace at which they were hitting for another five minutes, their performances for fifteen minutes would have been 15 3/32 inches for single-jacking and 23 1/2 inches for double-jacking. Many old-timers could doubtless have done that well without getting up a good sweat. Comparing the recognized record performances on a per-minute basis, the figures would be 1.006 inches against 1.7 inches in single-jacking, and 1.57 inches versus 3.1 inches in double-jacking.

The disparity between past and present achievements doesn't mean that rock is harder than it used to be or that men are softer. Rather, the explanation lies in the fact that hand drilling is pretty much of a lost art—has been pushed almost into oblivion by the mechanical rock drill. The stellar drillers of a half-century ago swung hammers in mines every day to earn their keep and naturally became adept at it. Furthermore, they trained long and hard in preparation for contests. They were very serious about it because there was more at stake than there is now. To the winners went not only substantial purses but also considerable honor and acclaim.

In contrast, 4- and 8-pound hammers are strange tools in the hands of today's miners, who have become accustomed to letting air power do their pounding. Entering them in a hand-drilling contest is something like pitting a modern automobile driver against a tough old Roman of Caesar's time in a chariot race. The outcome would never be in doubt.

KEEPING BUTTE THRIVING

THREE years ago the Anaconda Copper Mining Company announced, through Cornelius F. Kelley, chairman of the board of directors, that it would spend upwards of $20,000,000 to provide facilities for the recovery of some 130 million tons of ore above the 3400-foot level of the Butte, Mont., copper mines. The ore was left there during previous mining operations, some of it because it was of low grade and the remainder because it was inacessible or was needed in pillars to support the underground workings. Last month, as guest speaker at a dinner of the Butte Development Association, Mr. Kelley reported that the undertaking, known as the Greater Butte Project, is proceeding according to schedule.

The scheme's success depends upon the handling of vast tonnages daily to obtain a low unit cost, and this calls for extensive preliminary steps. These include filling worked-out openings in the mines with nine million tons of mill tailings, sinking a new production shaft, and installing an underground railroad system that will transport 100 tons of ore per train-trip. The shaft, 20x9 feet in cross section, will be one of the nation's largest. It is being equipped with two hoists of 3000 and 2250 hp.

On the basis of an estimate by Anaconda engineers the ore contains an average of 20 pounds of copper per ton, which means that this secondary mining venture will yield 2.6 billion pounds of metal valued, at the present price, at more than $600,000,000. Meanwhile, the extraction of higher-grade copper ore from other zones will continue as usual. These "regular" mining operations are still extensive. Last year Butte, and the refining plant at nearby Anaconda with which it is integrated, contributed $100,000,000 worth of metals to the country's total, and their workers received $40,000,000 in wages. Although copper is Butte's most important metal, it has lots of zinc to be mined, and one of its properties is the country's largest source of high-grade manganese ore.

Consummation of the plan amounts to breathing new life into Butte and insuring the famous camp many more active years. With that prospect in sight, the Butte Development Association was formed to improve its living conditions. Already the organization has been responsible for the building of 400 homes, and 250 more are under construction. New business buildings, schools, and churches also are going up. As its contribution to the movement, the Anaconda Company is erecting a new hospital for presentation to the community.

Thus Butte, which numbered only half as many people during World War II as in World War I, is laying the foundation for a future of assured prosperity. Long known as "the richest hill on earth," it promises to yield many more millions worth of metal before its glamorous record is completed.

PORCUPINE'S FIRST BILLION

THE Porcupine District in Canada's Province of Ontario has reached an official production of a billion dollars worth of metal, almost all of it gold. Few mining camps have compiled such a total. By way of comparison, Porcupine's gold output, which now stands at approximately 33,760,000 ounces, has been exceeded by but two states in this country —California and Colorado. Even South Dakota, with its fabulous Homestake Mine, has yielded only about two-thirds as much as Porcupine.

Porcupine's mineral wealth was not discovered until 1911, so its operating period encompasses but 40 years, or less than half that of the California and Colorado mines. The leanest year was the first, when the output had a value of but $15,437. In the peak year of 1941 it exceeded $55,000,000. All told, to June 1, 1950, the district has treated 117,878,184 tons of ore, with the recovery of bullion per ton averaging $8.50. Among currently active mines the grade ranges from $4 a ton to around $14.

Three mines have contributed 88 percent of the $300,000,000 in dividends paid on the first billion. They are the Hollinger, McIntyre, and Dome, which are still going strong. In all, eighteen properties, of which twelve continue to produce, have been dividend payers.

With the deeper workings in some mines now close to or more than 7000 feet below the surface, ore-extraction costs are naturally on the increase, but operations are still highly profitable. It is too soon to speculate on the chances of Porcupine reaching the two-billion-dollar mark, but that is within the realm of possibility, especially if the price of gold should again be advanced as in 1933.

This and That

Rare Woods Coming

In the course of 1950, rare tropical woods from the French Cameroons in Africa will start coming to the furniture and cabinet makers of the United States. Using funds supplied by the Economic Cooperation Administration, a French firm has established a sawmill and logging camp in the Cameroons jungle and expects to turn out 540,000 cubic feet of lumber in its first year of operation. The woods include ekki (or bongossi), atonu, aszenia, iroko (or roko), apara, and mahogany. The latter is the only one that has been used to any great extent in America. The logs will come from a concession covering almost 1000 square miles and will be sawed into boards with the aid of $1,600,000 worth of American machinery. A crew of 120 natives will be directed by American and French experts.

★ ★ ★

Modified Refining Process

The petroleum industry reports a new refining technique that is a modification of the Thermafor catalytic cracking process. One of the principal changes is the substitution of air for mechanical buckets to transfer the catalyst from the regenerator to the reactor. The regenerated pellets are lifted 200 feet through a 16-inch-diameter pipe at the rate of 250 tons per hour by low-pressure air supplied either by a separate blower or the bank of blowers that furnishes combustion air for burning carbon off the catalyst. The process is licensed by Socony-Vacuum Oil Company, Inc., and according to reports it will be in commercial operation in ten new plants in the United States and Europe by the end of the year.

★ ★ ★

Mine Wastes Spur Growth of Vegetables

Tailings from ore-reduction mills, hitherto a source of headaches for mining men, may be used in the future to fortify farmlands with minerals that have been withdrawn by growing crops. Experiments with plants on a small scale indicate that their yield can be measurably increased by adding these highly mineralized wastes to the soil, and further research promises disclosures that may, perhaps, have far-reaching effects.

Some of the latest information along this line came out of a recent meeting of the Clear Creek Metal Mining Association held high in the Colorado Rockies at Silver Plume only a few miles from the scene of the initial Colorado gold strikes of 1859. Since that time, mining has been just about the region's sole industry, and its stamp mills have pulverized millions of tons of ore to permit the extraction of precious metals, chiefly gold and silver.

The main speaker, A. T. Sweet of the U. S. Bureau of Mines, explained that certain metals such as cobalt, zinc, silver, iron, selenium, and boron, as well as many nonmetallic elements, are necessary for healthy animal or vegetable growth. In all growing things nature provides catalysts to transform these substances into assimilable forms. On many farms, however, the minerals have been literally "mined out." This deficiency has affected both the taste and nutritional value of many vegetables. Carrots and potatoes are notable examples. In the case of the latter, evidences of a lack of these ingredients are scaly skins and hollow spaces or splits inside. Deficiencies in wheat are well recognized, as is attested to by the fact that many bakers now add vitamins to their bread. Animals subsisting on feed from mineral-starved lands fail to develop normal weight and, in the case of cows, give reduced quantities of milk.

Practical corroboration of Mr. Sweet's statement that piles of tailings may be put to use in correcting this dearth of minerals was given by several miners, who evidently are conducting some experiments of their own. Two of them, who live some miles apart, report that by mulching tomato plants with small quantities of powdered minerals they have been able to increase the yield as much as 12 pounds per plant. They have also improved the size and appearance of various flowers.

Price Briscoe, a mine operator who represents his district in the Colorado State Senate, told of research he has been conducting in conjunction with the Bureau of Mines laboratory. When a handful of tailings, that had been placed on a stove to burn off the sulphur, was added to the soil of a vegetable garden the plants took on new life and attained unusually fine flavor.

Since mining began in the West a century ago, tailings have presented a big problem. At first operators discharged this mill waste into streams, but the practice was soon banned by legislation because it killed fish, clogged up irrigation ditches, and covered farmlands with fine sand. Construction of retaining ponds then became necessary, and as the stuff accumulated the expense of caring for it mounted. Consequently, mining men have always looked upon tailings as a liability. Now, however, they may find that they are an asset. Continued research will possibly bring these millions of tons of silt-like material into demand for use on farms.

Incidentally, the conference brought out a possible explanation for the fact that "bottom" lands on the lower reaches of streams flowing from mining districts invariably produce vegetables of high quality. This is true around Denver, for example, on land bordering Clear Creek which for decades has carried mill tailings down from the area where the discussion was held. The reason given for the fruitfulness of these fields was that, during high-water periods, they have periodically received infiltrations of minerals that stimulate plant growth.

★ ★ ★

Ancient Gold Mine Operating

Since 1948, the Egyptian Mining & Prospecting Company has been operating a gold mine in the hills of northeastern Thebes that is believed to be on the site of workings that date back 4000 years. Legend has it that the property yielded some of the jewels and trinkets that archeologists have found in recent years in some of the tombs of early Egyptian rulers, including that of King Tutankhamen. The results obtained so far are reported to be so favorable that the company is adding to its plant. The ore is mined through a shaft and is treated by means of a combination of amalgamation and cyanidation.

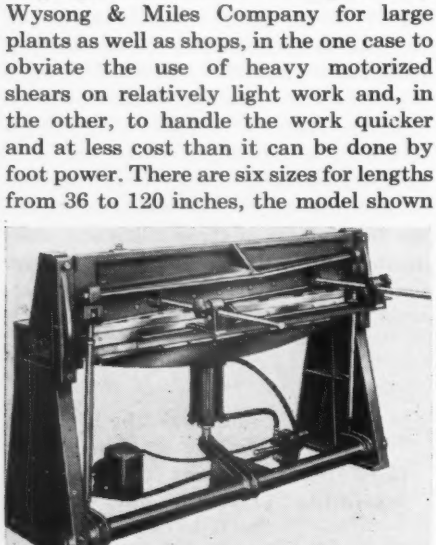
★ ★ ★

Subway Builders' Heaven

American contractors engaged in the construction of Canada's first subway underneath Yonge Street in Toronto have encountered a number of surprises. Contrary to the custom in this country, the city did not attempt to maintain traffic over the street while excavating was in progress, but discontinued operating streetcars and barred the thoroughfare to vehicles. This simplified the problem and expedited the work on the first contract covering a 1-mile stretch in the congested area. Further, the authorities insisted that construction above street level was to be discontinued during the month of December in order that Christmas throngs could shop without interference. By careful planning, the contractors were able to comply with these stipulations. Thus far the American firms have found common labor plentiful and anxious to work, but have been somewhat impeded by the scarcity of artisans and have had to train some men for special jobs. Where structures flanking the street have had to be shored up, however, it was found that men from Canadian mines became excellent underpinners after a few days of instruction.

Industrial Notes

Air-operated shears for cutting 16- and 18-gauge sheet metal are being built by Wysong & Miles Company for large plants as well as shops, in the one case to obviate the use of heavy motorized shears on relatively light work and, in the other, to handle the work quicker and at less cost than it can be done by foot power. There are six sizes for lengths from 36 to 120 inches, the model shown

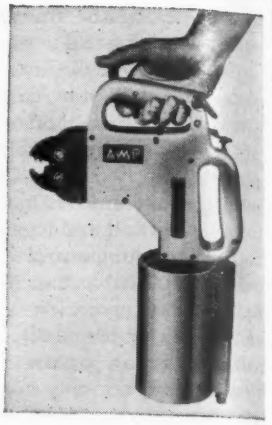


being designed to cut 16-gauge mild steel 52 inches long. It is operated by one air cylinder, the three larger sizes having two each. All are controlled by a foot valve provided with a housing to protect the operator's foot and to prevent accidental tripping. Air at 70 to 85 psi. is used and is provided by 1½- to 5-hp. compressors, depending upon the size of the shears and the number of cutting strokes per minute. Pressure on the air valve brings the blades into action; release returns the knife bar and hold-down to shearing position. Machines are ready for service when air connection is made.

Flexrock Company advocates keeping on hand a supply of its new roofing compound which, it claims, will stop a leak quickly and permanently. It is sold ready mixed and can be applied cold while rain or snow is falling.

As a coating for hot metal surfaces such as boiler fronts, furnaces, baking ovens, hot-water heaters, steam lines, etc., The Skybryte Company is offering an aluminum paint that is said to withstand a temperature of 1000°F. without blistering or flaking. It is suitable for brush or spray application.

Previously available only in a size for handling No. 22 to 6 wire, Aircraft-Marine Products Inc. is now offering a larger air-operated tool that is designed to crimp solderless terminals to wire ranging from No. 22 to 1/0 (American Wire Gauge). Like the earlier model, it has two handles, each with its own trigger, a loop for suspension, and detachable heads for end- or side- position crimping. Hardened toggle-action jaws are operated by use of an air cylinder of tool steel and complete their crimping cycle at one stroke with shop air at 85 psi.

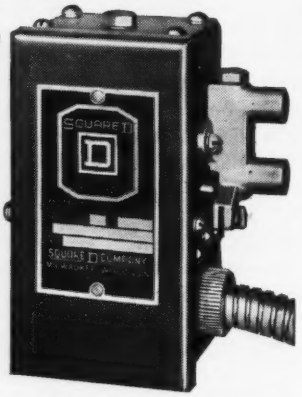


For the removal of small ferrous parts and contamination from electroplating tanks, acid or alkali baths, etc., Eriez Manufacturing Company is making a permanent magnetic device that functions much like a carpet sweeper. The magnet is in the form of a tube and mounted between Neoprene wheels. As it is moved along the tank bottom by a long handle, it rotates, attracting nails, screws, and the like, which attach themselves throughout its entire circum-

New CLASS 9045 TYPE BG MAGNETIC UNLOADER

Provides POSITIVE unloading of air-compressor at end of operation or when voltage failure occurs

FEATURES



- Release valve is located conveniently on the side of the unloader enclosure. Moisture, condensed by the rapid expansion of the unloaded air, is blown into the atmosphere. The solenoid coil and interior working parts remain dry and free of moisture.
- Coils are available for use with all standard voltages and frequencies. Dual voltage coils are commonly furnished in 110/220 V and 220/440 V ratings.
- Magnetic unloaders can be furnished with either two-way or three-way valves. The two-way valve exhausts the air between check valve and compressor head directly into the atmosphere. The three-way valve serves as an auxiliary valve to provide actuating air for a compressor unloader.

Write for Bulletin 9045, Square D Company, 4041 N. Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

AIR trap selection and installation for automatic drainage of water from compressed air intercoolers, aftercoolers, receivers, separators and drip points are fully described. Helpful sections include typical installation diagrams, illustrations of the various models of Armstrong Air Traps, their applications and operation, and their materials (cast or forged steel bodies and caps, chrome steel valves and seats, stainless steel interior parts). Physical data and list prices complete the story.

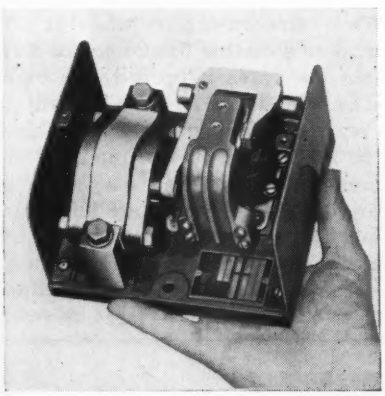
There's enough information here for anyone to make the most effective air trap selection for *any* moisture drainage job, any pressure or capacity range. FOR YOUR COPY, WRITE:

ARMSTRONG MACHINE WORKS
885 Maple Street Three Rivers, Michigan

ference to a thickness of about ¾ inch. Release is effected by pushing the parts by a wiper ring to either end of the tube, where there is a nonmagnetic section.

American Air Filter Company has announced the development of a new type of replaceable air filter for forced air-heating and ventilating and air-conditioning systems. Named Amer-glas, the filtering medium consists of continuous, interlaced glass filaments held together by a high-temperature plastic to form a thick resilient pad sprayed with Viscosine—a noninflammable adhesive—and placed in a fiberboard casing between metal grilles. The filter is available in two thicknesses—1 and 2 inches—and in seven standard sizes.

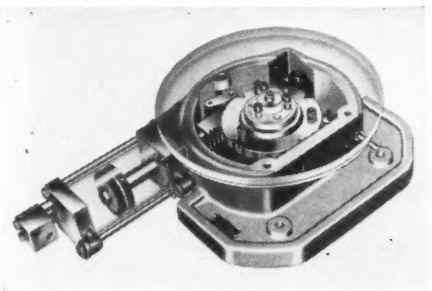
By applying rotary action to a magnet-operated air valve, Square D Company has developed a unit of extremely small size of high capacity and fast operation. Designed as a 4-way, 4-port, ⅜-inch valve for the control of double-acting pneumatic cylinders, it can be converted to 3- or 2-way service by plugging the proper ports. The magnet is of



the direct-acting type, and the rotor, which is pressure balanced to minimize bearing wear, has spring-loaded vanes to insure a positive seal. According to the manufacturer, the valve will function continuously at 300 cycles per minute and intermittently at speeds up to 600 cycles per minute. It is suitable for pressures up to 100 psi. and can be mounted in any position.

Gauges, piston rings, cylinder walls, and the like, can be given increased wear resistance by a new plating developed by the National Bureau of Standards. It consists of cobalt or nickel alloyed with as much as 15 percent phosphorus and is deposited electrolytically more easily than chromium. The resultant surface is said to be bright, very hard, and corrosion resistant.

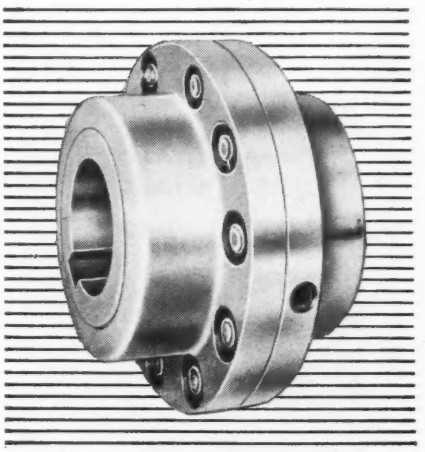
Improved dial feed tables with completely enclosed working parts have been announced by The A. K. Allen Company. They are powered by a 2¼-inch double-acting air cylinder through a rack which is attached to the piston rod and drives a gear carrying a pawl which actuates the index plate. The standard table has an indexing range from 4 to 24 and is designed to use a baffle when set for less than 24 stops. The changeover from one



setup to another can be made in less than fifteen minutes, it is claimed. To permit secondary operations, a rod, extending through an Oilite bushing, moves outward to operate a valve or microswitch. Indexing accuracy to within plus or minus 0.002 of nominal, measured at the periphery of the 11-inch nest plate, is guaranteed. The accompanying phantom view shows a table set to index at four stations.

Adhesives, flammable and explosive materials, and other fluids that can be mixed by an oscillating beater can be handled, it is claimed, by a new type of variable-speed mixer introduced by The Union Tool Corporation. Attached to the side is a double-acting pneumatic cylinder that can be regulated to drive the beater anywhere from slow to fast just by turning an air valve partly or all the way on, the pressure used depending upon the material being handled. With air at 50 psi., the oscillations may be varied from 0 to 90 per minute. If fluids are to be delivered from the mixing tank direct to a packaging machine, a pipe line is attached to the drain, the upper part is converted into a pressure vessel by screwing the top down tight, and compressed air is applied to the free surface of the material to force it out. In the case of liquids that tend to separate, the agitator is kept in motion during the dis-

Why settle for less?



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WALDRON

the advanced gear type

Coupling

Once you have examined its improved design and construction features with those of other couplings of its type you will agree that this Waldron Coupling gives you the most for your money in safety and service. Note these features:

1. A one-piece steel forged cover sleeve.
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3. Absence of trouble-causing parts in its construction.
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5. More compact design to permit use of larger shafting.

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NAYLOR PIPE

Once you work with Naylor Pipe, you'll know why so many contractors depend on it.

No other light-weight pipe can give you Naylor performance because no other pipe has the exclusive Naylor Lockseam Spiralweld structure. This difference adds up to pipe that is extra strong and safe, easy to handle and install—pipe that gives you *plus* value right down the line.

Job-prove these Naylor advantages for yourself. Whether it's pipe for high or low pressure air and water, de-watering and drainage, dredging, hydraulic sluicing, sand and gravel conveying or other service, you'll do better with Naylor.

Sizes from 4 to 30 inches in diameter, lengths up to 40 feet, thicknesses from 14 to 7 gauge. All types of fittings, connections and fabrication.

NAYLOR PIPE COMPANY
1245 East 92nd Street, Chicago 19, Illinois
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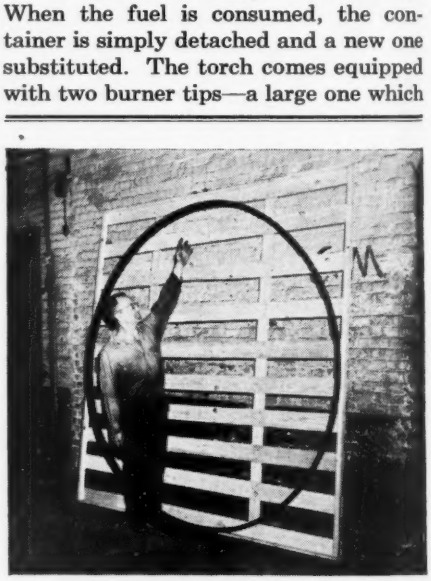
charge period. The Union mixer is available in two sizes with capacities of 10 and 20 gallons and with cold or hot jackets for special needs.

Acid leaching out from spoil banks in strip mining has been effectively sweetened by bringing it in contact with limestone that has been crushed and dumped into a trench dug around the toe of the waste material.

The razor-blade idea has been applied to plowshares by Dearborn Motors of Detroit, Mich., which now makes plows on which shares dulled through use can be easily replaced with sharp ones. By thus obviating the need of resharpening conventional shares, it is claimed that farmers can save as much as $40 per 100 acres plowed.

A new fuel in a throw-away container and an appliance designed to use it form a hand torch that is ready for service the instant it is lighted. The fuel is a liquid composed of several petroleum hydrocarbons and is self-pressurizing, self-vaporizing, nontoxic, and nonpoisonous. It comes sealed in a seamless metal container about the size of a beer can, with a rubber valve on top by which it is attached to a mating fixture on the torch. When the valve is opened, the burner can be lighted with a match and will give its maximum heat of 2200°F. within 30 to 60 seconds. Pouring, pumping, and priming operations, necessary with conventional blow torches, are eliminated. When the fuel is consumed, the container is simply detached and a new one substituted. The torch comes equipped with two burner tips—a large one which



BIG PACKING FOR AN AIR CLUTCH

Built in sections, assembled, and completed as a single piece, this leather packing is the largest ever made by E. F. Houghton & Company. It has an outside diameter of 91 inches and will be used to clamp friction plates together in an air-operated clutch on a 25-foot-high hot forging press. The frame of the latter will be a single casting weighing 475,000 pounds, and there is only one flatcar in the United States equipped to carry it.

throws a long, broad flame for work where a lot of heat is required quickly, and a smaller one which emits a pinpoint flame for soldering or other operations where heat must be concentrated on one spot. Both the fuel and

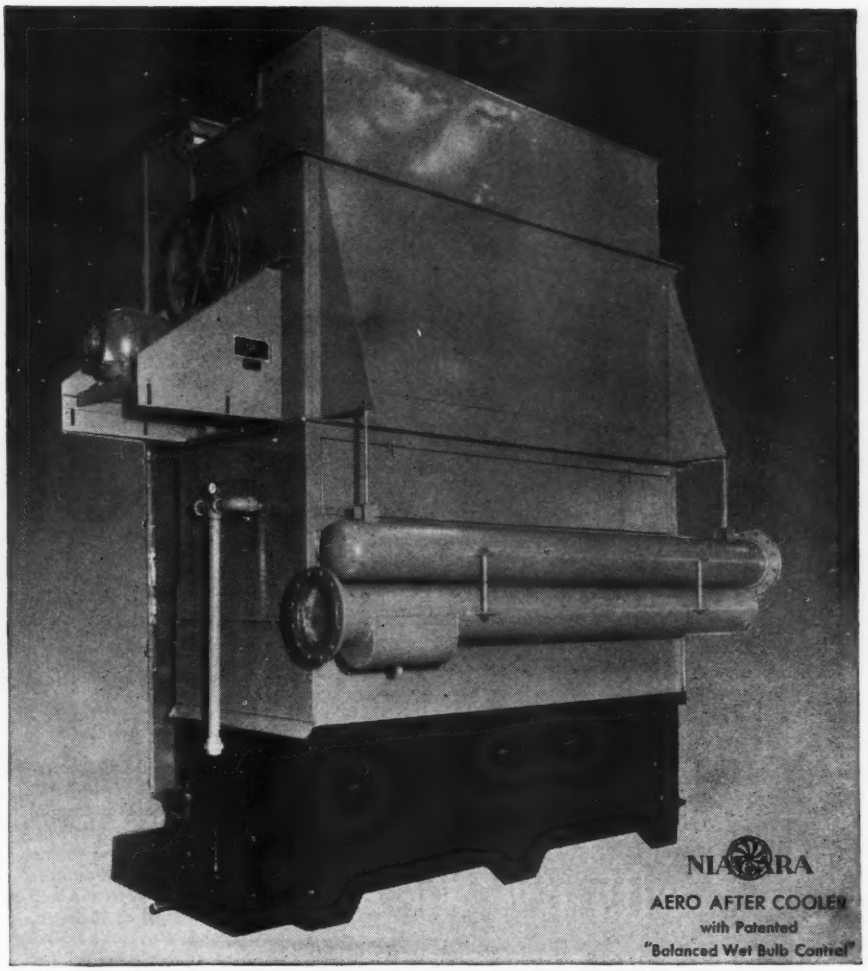
torch are being introduced by Pressure Products Corporation under the name of Prepo. Other devices such as a refrigerant leak detector, a solder dip pot, a weed burner for home gardeners, a camp stove, etc., are being designed for use with the canned fuel.

Liquid flux in a squeeze-squirt container is a work-saver, says the Division Lead Company, which is marketing the new product. It is packed in a 4-ounce can which, under slight pressure, directs a fine stream on the parts to be soldered. Designated as Divco No. 229 Liquid Soldering Flux, it virtually eliminates the usual cleaning and burnishing and is suitable for all metals.

Stiffening ribs and a suspension hammock are two features of E. D. Bullard Company's new Hard Boiled safety hat. Fashioned of aluminum alloy with a nonglare finish, the ribbed design gives the 12-ounce headgear high impact resistance, which is increased by the full-floating inner assembly or hammock. The latter and the headband can be adjusted without tools to fit heads of all shapes and sizes.

In prestressing concrete it is the practice to use wire generally not exceeding ¼ inch in diameter. It is therefore of interest to learn that a London (England) consulting engineer, in coöperation with McCall & Company, Ltd., manufacturer of reinforcing materials, has developed a corrosion-resistant alloy steel and special nuts and jacks that make it possible, it is claimed, to substitute bars up to 1⅛ inches in section for the wire.

National Utilities Company's pressure-reducing valve, which has been used for years in connection with household



How to PREVENT CONDENSATION in COMPRESSED AIR LINES

● Users of pneumatic tools and machinery spend thousands of dollars on repairs and suffer much interruption to production from the condensation of water in their air lines. In compressed gas systems and in processes where compressed air is blown directly on parts and materials in production, there is additional damage.

You can prevent these losses by installing a Niagara Aero After Cooler. It cools the compressed air or gas by evaporative cooling and removes the water before the air enters the receiver. This method brings the air to within a few degrees of the wet bulb temperature, making certain that your compressed air will always be colder than the atmosphere surrounding the lines in your plant, so that no further condensation can take place.

Savings in cooling water pay for the installation. Experience shows that the patented Niagara evaporative cooling method consumes less than 5% of the water required for cooling by conventional means. You save the cost of the water, the cost of pumping it, the cost of disposing of it. These extra savings soon pay for the Niagara Aero After Cooler.

Write for Bulletin No. 98

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Over 35 Years of Service in Industrial Air Engineering

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District Engineers in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

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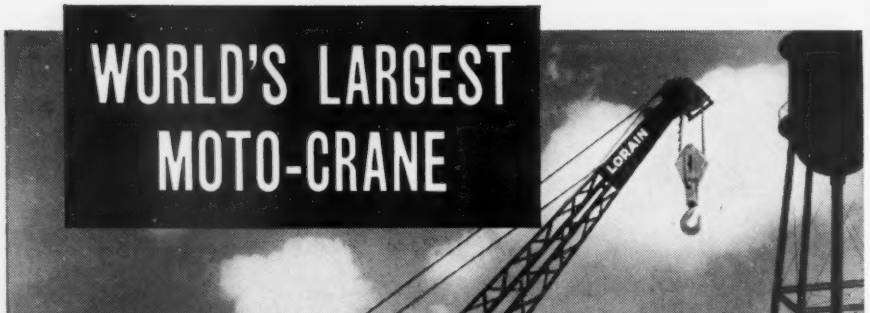
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

WORLD'S LARGEST MOTO-CRANE



lifts and transports up to 45 Tons with its two WAUKESHA *Diesels*

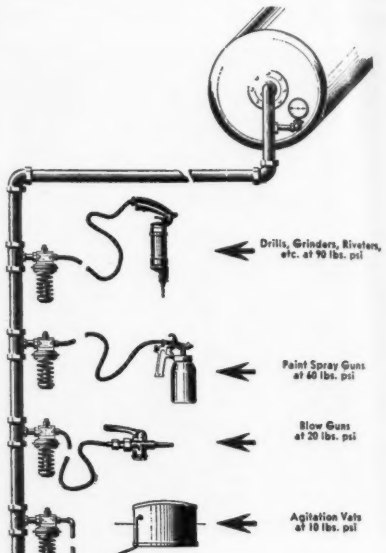
The *Lorain* MC-820 Moto-Crane has two WAUKESHA Super-Duty DIESELS (Model WAKD) six cyl., 6¼ x 6½ in., 1197 cu. in. displ. One engine propels the rubber-tired carrier which transports the unit (weight 65 tons) at 18 m.p.h. The second Waukesha Diesel installed in cab of crane (as shown below) powers revolving turntable, hoist, swing and boom derricking; supplying power to lift loads up to 90,000 lb.

● New fields in heavy material handling by mobile equipment, are being opened by this giant, rubber-tired two-engined crane. Said to be the world's largest, the first of these Waukesha-Diesel-powered Lorain MC-820 Moto-Cranes is working in the world's largest steel mill. It has a safe-rated lifting capacity of 45 tons (90,000 lb.) at a 12-ft. radius. Thirty years ago when Thew built the first portable crane—also a Waukesha-powered Lorain—its capacity was only 3½ tons. The latest Lorain's ability to lift and transport far heavier loads than any previous portable crane, extends the basic advantages of the moto-crane for handling heavy material in steel mills, steel erection, ship and bridge building, oil fields, logging and many other industries.

A crane is no better than its engines. With their 30 years of motorized crane experience, Thew Shovel Company engineers chose two big Waukesha Super-Duty Diesels to power the world's largest moto-crane. Waukesha Diesels are winning recognition everywhere as the world's finest power plants of their size and type. Get Bulletin 1415.

WAUKESHA MOTOR COMPANY • WAUKESHA, WIS.
NEW YORK • TULSA • LOS ANGELES

water pumping systems activated by compressed air, has recently been adapted for application with air tools. Of the diaphragm type, a group of them can be interposed in one standard ½- or ¾-


Drills, Grinders, Riveters, etc. at 90 lbs. psi
Paint Spray Guns at 60 lbs. psi
Blow Guns at 20 lbs. psi
Agitation Vats at 10 lbs. psi

inch line to deliver air differing in pressure from 5 to 100 psi. to drills, spray guns, etc. Any pressure within these limits can be set to gauge by twisting an adjusting handle at the bottom of the valve and is held constant, even with fluctuating air-receiver pressure, by a ¼-inch heavily enameled steel spring on the handle.

It is claimed that unglazed masonry such as cement and concrete blocks, brick, stucco, and stone can be both colored and protected against spalling, cracking, crazing, and disintegration by a new water-repellent offered by The Tremco Manufacturing Company under the name of Tremco 101 Mastic. It comes in yellow, terra cotta, dark red, slate, off white, and natural and is applied to large buildings, industrial or residential, by the spray method or by brush or trowel to smaller surfaces.

Aluminum with twice the wear resistance of case-hardened steel is attributed by Glenn L. Martin Company to a new coating that is applied by an electrochemical process. Known as MHC finish, it ranges in thickness from 0.0001- to 0.006-inch, and provides a nonmetallic, highly heat-refractive surface that is firmly bonded to the base metal. Though developed by the company primarily for aircraft use, it enables industry to substitute light-weight aluminum for many items and structures that formerly required a heavier metal.

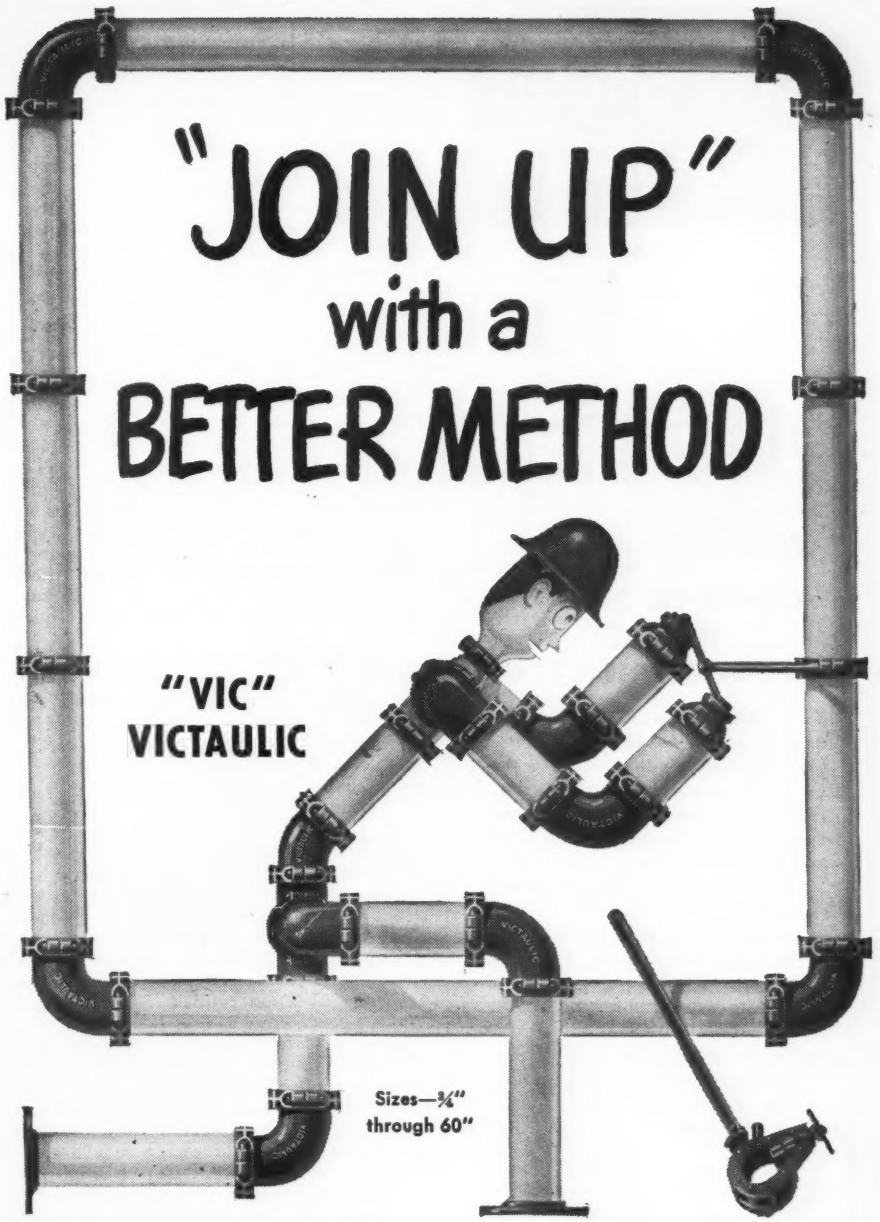
By means of a high-frequency induction heating unit it is possible to bring a 1-inch length of steel rod to a temperature of 1500°F. in about three seconds, according to Lepel High Frequency Laboratories, Inc., which developed the

equipment especially for hardening, annealing, normalizing, and soldering ferrous and nonferrous metals. It will melt 4 ounces of steel or brass in four minutes, it is claimed, and is also suitable for brazing carbide tips to cutting tools up to 1½ inches square. The unit is portable and designed to operate continuously. Low in cost, it meets the requirements of research laboratories and machine shops.

Construction on a million-dollar plant will soon be started by Babcock & Wilcox Tube Company at Beaver Falls, Pa., for the production of carbon- and alloy-steel tubes of complicated sectional shapes by an extrusion process that was developed by Comptoir Industriel d'Etirage & Profilage de Metaux and is in commercial use in France. Alloys that are difficult or impossible to handle by our present-day rolling mills and forging methods can be fabricated into hollow and solid sections by the patented process, which depends for its success upon a new idea in hot-metal lubrication—upon the solution of the problem of die and ingot-holder lubrication and thermal insulation. It is claimed that the extruding operation is performed in a few seconds at constant temperature, giving the product uniform mechanical characteristics throughout its length.

TIRE EXPERT FOR 50 YEARS

For four years following his graduation from Massachusetts Institute of Technology in 1896, P.W. Litchfield worked in various New England factories that made pneumatic tires for bicycles. On July 15, 1900, he joined Goodyear Tire & Rubber Company as superintendent of production, development, and engineering. During the ensuing 50 years he contributed numerous ideas for improving passenger-car tires and was a pioneer in the development of truck, bus, and airplane tires. Concurrently, he rose progressively to director in 1908, vice-president in 1915, president in 1926, and chairman of the board in 1930. He still holds the last-named post. He is pictured here on his fiftieth anniversary with Goodyear, helping Louis Park, company employee, lift the firm's 500 millionth pneumatic tire from its mold.



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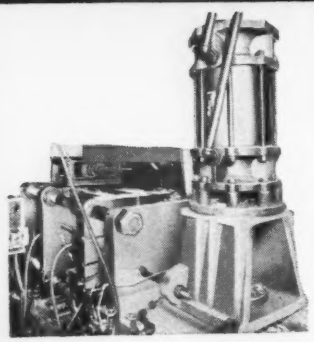

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Books and Industrial Literature

Engineering lessons learned the hard way in the construction of the Hoover Dam on the Colorado River have just been published in book form by the U.S. Bureau of Reclamation. The unprecedented problems and technical advances made in building the 726-foot structure and its giant power plant —second largest producer of hydroelectric energy in the world—are described in a series of 23 bulletins dealing with various technical phases of the 174-million-dollar project. *General History and Description of the Project, Hoover Dam Power and Related Data*, and *Geological Investigations* are the three main aspects covered. Copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., or the Bureau of Reclamation, Denver Federal Center, Denver, Colo., attention 841. Price of sets bound in cloth, $44.85; in paper, $29. Cost of the individual bulletins ranges from $0.50 to $3 and is given in a list furnished upon request.

An 8-page bulletin announcing a new iron-asphalt patching material for worn concrete floors has been issued by the Master Builders Company, Cleveland 3, Ohio. Photographs and diagrams show how Masterquick works and how it is applied. Contains a list of recommended uses and a table for estimating quantities.

A line of 2-stage water conditioners which makes use of a "hot" process followed by a zeolite softener is the subject of a bulletin issued by Cochrane Corporation, Philadelphia, Pa. It describes the units and lists among their advantages savings in floor space, head room, and chemicals. A copy will be sent upon request.

Management of Industrial Research is the title of a publication Arthur D. Little, Inc., will send free to interested persons. Consisting of a bibliography of carefully selected books and articles on the subject of industrial research and engineering, it is intended to help companies plan their research policies and procedures. Requests should be directed to the firm at Cambridge 42, Mass.

Functional Photography is the title of a 16-page picture booklet that describes how photographs and photographic equipment are used in industry. Typical applications shown are high-speed motion pictures, photomicrography, spectrography, photographic stress analysis, instrument recording, microfilming, visual training and printing. To get a copy of the pamphlet write Eastman Kodak Company, State Street, Rochester 4, N. Y.

Dehumidification is discussed briefly in a new bulletin which describes the Model ACR-3 dehumidifier, built by the Chrysler Corporation, and a direct-reading humidity indicator called the Hygrodial made by the Bendix Aviation Company. Typical installations are listed and a table of recommended humidities is given. Pamphlet may be obtained free of charge from the supplier, the Abbeon Supply Company, 58-10 Forty-First Drive, Woodside, New York, N. Y.

A new bulletin, titled *The Terry Multistage Turbine*, has been published by Terry Steam Turbine Company, Hartford, Conn. Installation photographs, detail drawings of component parts, and construction features of casings, blades, nozzles, wheels, shafts, diaphragms, bearings, interstage and end glands, governors, synchronizers, governor valves, steam strainers, auxiliary oil pumps, and lubricating systems make up the bulk of the contents. To get a copy address the manufacturer, Dept. P.

What is the Uni-Pull drive? is the title of a folder on belt-drive systems. Put out by the American Leather Belting Association, 41 Park Row, New York 17, it briefly discusses Uni-Pull drive and illustrates its important features, as well as three types of bases used to provide belt-tension control. Some typical applications are also pictured.

Technical data on its Geon latices—water dispersions of polyvinyl-chloride base resins —has been published in bulletin form by The B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio, and copies are available upon request. The pamphlet lists the individual properties of the six latices now being marketed, cites their fields of application, and discusses methods used by formulators.

Armstrong Machine Works, Three Rivers, Mich., has recently issued an illustrated bulletin describing its complete line of air traps for the automatic drainage of moisture from compressed-air intercoolers, aftercoolers, receivers, separators, and drip points. How to select and install the various models and how they work are covered in some detail. Copies are available upon request.

DuoFlo duplex oil strainers are the subject of a new bulletin—No. 100—published by the Sheffler-Gross Company, Drexel Building, Philadelphia 6, Pa. They are suitable for use on either the suction or discharge sides of oil pumps and are furnished in cast iron or steel. Besides detailed descriptions, sizes, and prices, the pamphlet gives cleaning instructions and manufacturing data.

Now available are two technical bulletins on the engineering properties of high-nickel alloys. One, T-7, covers Inconel; the other, T-9, deals with "K" and "KR" Monel. Both pamphlets contain charts, tables on composition and properties, working instructions, and other information. They can be obtained through the Technical Editor of the International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

Automatic control for operation, limit, and sequence timing in thousands of industrial processes is the function of a new electronic timer announced in a bulletin released by General Electric Company, Schenectady 5, N. Y. Devices with three time ranges—0.06 to 1.2 seconds, 0.6 to 12 seconds, and 6 to 12 seconds—are listed, and schematic diagrams show the basic principles upon which they operate. The publication can be obtained without obligation by writing to the company.

An old trick of the chemical laboratory, that of using previously formed precipitates to accelerate chemical reactions, is the basic principle of a new sludge contact reactor announced in a bulletin obtainable from Cochrane Corporation, Philadelphia 32, Pa. The 16-page illustrated booklet gives the background of the method and outlines features of correct reactor design. It also explains how the device works, gives descriptions of two fundamental types of reactors, and lists applications. Auxiliary equipment needed and schematic diagrams of typical installations are included.